TECHNICAL REPORT

FD-9

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Contract No. DA 19-129-AMC-11(N)

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FOREWORD

The compression and dehydration of foods result in advantages of both economic and military importance. In addition to the obvious savings in transportation and storage space, there is increased efficiency in the military utilization of the food at critical points in the field. The moisture sorption properties of these foods are important in relation to the storage stability, packaging compatibility and rehydration. Information in this area is presently fragmentary and limited. Specifically, no information exists on the moisture sorption properties of compressed multi-component food rations under controlled conditions.

The work covered in this report was performed by the FMC Corporation, Central Engineering Laboratories, under Contract No. DA19-129-AMC-11(N), during the period from 31 July 1963 to 31 July 1964. It represents an investigation of the effects of compression and storage on 8 combination foods, in terms of component compatibility, moisture sorption characteristics and storage stability. In a previous report (Phase I of the same contract), the moisture sorption characteristics of 12 single, compressed, dried foods were studied.

The results of this study indicate that the development of compressed multi-component food rations with high acceptability and with good storage stability is a distinct possibility. These findings will have direct application to any further developmental work on compressed foods.

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ABSTRACT

This report covers the study pertaining to the effects of compression and subsequent storage of eight combination foods on compatibility of components, moisture sorption characteristics and storage stability. Compression did not produce any differences in equilibrium relative humidity moisture contents. Storage stability as measured by changes in chemical composition and organoleptic acceptability was not significantly affected by compression. Storage relative humidity and time were the major factors in storage stability. The results indicated that the optimum storage relative humidity was 7% or less. Moisture sorption isotherms are included with tabulation of chemical, organoleptic and rehydration data for all eight food combinations.

I. INTRODUCTION

The maximum logistical advantage of stabilized lightweight but bulky dried food can be achieved by reducing the volume to a minimum. As a result, there is renewed interest in the volume reduction by compression of dried foods.

This is the final report of the work initiated under Phase II of Quartermaster Corps Contract DA 19-129-AMC-11(N). The objectives of this contract are to determine the effects of compression of multi-component dried foods. Specific studies, set up to meet the objectives, included measuring the rate and level of moisture equilibration at specific relative humidity levels, measuring the levels of important chemical constituents after specified storage intervals, measuring the rehydratability characteristics and determining the organoleptic acceptability.

II. EXPERIMENTAL

To best describe the experimental procedures, this section is divided into three phases of work:

1. The selection and preparation of the individual foods, including calculations for combinations and compression procedures employed.

2. The procedures used for the moisture sorption study and the corresponding sample preparation procedures.

3. The chemical and organoleptic methods used to determine storage deterioration characteristics.

A. Foods used in the tests

1. Individual foods for the test

The basis for selection of the individual foods was specified in the contract and was based on Salwin's (1) classification of foods. The dried foods used in the studies are listed in Table 1, along with the source of supply and method of drying.

Because of the availability of data, foods chosen for the Phase II studies were selected from those studied in Phase I.

All of the raw materials for the FMC runs were purchased from local food packers or commercial outlets in frozen sugar-free packs.

The food items requiring freeze-drying were prepared using FMC freeze-drying equipment and then maintained under conditions which, through past experience, result in a high quality product. The solidly frozen product particles were evenly spread on trays, placed in the freeze-dryer and the vacuum was rapidly brought to 200 microns of mercury, absolute; the heating plate temperatures were set at 130° F. To insure thorough drying, a 16-hour drying cycle was used and upon completion of drying, the vacuum in the drying chamber was broken with nitrogen gas. The trays were then removed and the products packaged immediately in a low-humidity room. All lots of each food item were packaged into large double-walled polyethylene bags (6 mil per wall thickness) under a steady bleed of nitrogen gas. Each filled bag was sealed and stored in an outer-sealed metal container for at least a week to permit moisture equalization before using in any sample preparation. The bagged samples stored in this manner also served as control samples.

2. Food selection for the compressed food combinations

It was specified in the contract that eight different combinations of the various dried foods were to be studied. In the selection of the component foods that went into making the compositions, the following criteria were considered in arriving at the final combinations:

a. The probable ultimate use and the common or conventional association. An example of this would be a meat-with-vegetable dish that would be regarded as a basic serving, i.e., beef and potatoes, beef and spinach.

b. Interclass combinations of foods. Since the moisture sorption isotherms of products within a class are similar, it is expected that a minimum of moisture exchange would occur. As a result, some of the combinations have individual components representing different classes of food.

c. Phase I of this contract dealt with the study of moisture sorption of individual compressed foods. Since an evaluation of the effect of moisture sorption properties on compressed combinations is desired, the foods for Phase II were selected from among those studied under Phase I.

d. To obtain data on the effect of variation in the ratio of one ingredient to the other, two combinations were chosen to be variations of two others.

e. Powdery homogeneous materials (eggs, potato) as well as larger particled items (beef, spinach, cabbage, carrots, apples and strawberries) were used for making the compressed compositions. To effect uniform distribution of components, the maximum size of the food particles was 1/2 inch in diameter.

f. The foods used in the test included foods dried by air and by freeze-drying.

3. Calculation procedures for food combinations

From the foods selected for this project, it was possible to get one combination for each of the five equilibrium relative humidity ranges specified in the contract. The following two analyses were essential in calculating the ratio of components.

a. Moisture analysis
The initial moisture content of the individual foods, the basis for calculating the food combinations and subsequent weight changes, was done by drying in vacuum of 28" of mercury for 16 hours at 70° C. Duplicate moisture analyses were done on a composite sample taken from various parts of the double-walled poly bags.

b. Lipid analysis
All moisture data for the fat-containing food items was expressed on the fat-free basis and lipid analyses were required on the individual dried beef and egg. Duplicate samples were weighed into Soxhlet thimbles and extracted with petroleum ether for six hours.

A formula derived from Salwin's method (2) of calculation for computing the equilibrium moisture distribution of dried food combinations was used in determining the make-up ratio of the two food combinations which would result in the equilibrium relative humidity ranges specified in the contract. Salwin's formula for computing the equilibrium relative humidity of combinations is as follows:

$$R = \frac{R_A S_A W_A + R_B S_B W_B}{S_A W_A + S_B W_B}$$

W_A, W_B: dry weights of the two components
R_A, R_B: initial relative humidities of the two components
S_A, S_B: slope of the isotherms between initial and final points

Setting $W_A + W_B$ equal to one, then $W_B = 1 - W_A$. Substituting this in the above formula, the resulting formula

$$W_A = \frac{R_B S_B - RS_B}{(RS_A - RS_B) - R_A S_A - R_B S_B)}$$

can then be used for calculating the ratio of the component foods. The slopes for the isotherms were taken from data gathered in the first phase of the contract. Table 2 lists initial moisture contents of the component foods and the food combinations with the calculated equilibrium relative humidity ranges for each. The final combination ratios were to some extent influenced by the thought that any combination component should make up a noticeable fraction of each disc.

4. Compression of combination dried foods

The contract specified that two pressure-dwell combinations within the range of 300 - 1,000 psi be applied on each of the eight combinations. Based on the compression studies of Hamdy [QMCIAF Report, Contract No. DA 19-129-AMC-1630 (1961)], the USDA publication No. 647 (1948), Experimental Compression of Dehydrated Foods, and most of all the compression results of the first phase of this contract, two pressure levels were selected for each combination that produced the desired characteristics. Table 3 lists the two pressure levels used in producing the compressed compositions.

In the succeeding discussions, the terms P_1, P_2, and P_0 are used for reference to the pressure treatment. P_1 refers to the lower compression treatment, P_2 the higher level and P_0 the uncompressed control. All dwell times were 30 seconds.

The lower pressure levels were selected for their efficacy in producing cohesive discs 1/2" thick and 1 7/8" in diameter from a 20 - 25 gram sample of dried food. The selection of the higher compression level was based chiefly on the production of a disc which would not be too hard or brittle and possibly retard moisture absorption.

A deviation from the contract specifications were those pressures employed for producing a cohesive combination of beef and potatoes. It was first necessary to adjust the moisture level of the potato to about 16% and compress above the specified maximum pressure level to achieve the desired results. To increase the initial moisture level from 8% to approximately 16%, calculated amounts of water were sprayed onto weighed quantities of potato powder. These moistened potatoes were thoroughly mixed in a Waring Blendor before placing them in sealed jars for equilibration. The preparations were equilibrated at refrigerated temperatures to retard possible deterioration and were thoroughly agitated daily during the 8 to 10 day equilibration period. It was also necessary to chill the foods to 50° F. before compressing at the two levels.

B. Moisture sorption

1. Hysteresis studies

In the first phase, hysteresis studies were done on three foods by first equilibrating to an initial moisture level followed by interim equilibration to higher and lower humidity levels and finally equilibrating all the samples at the original relative humidity levels. Similar hysteresis studies with the single and combination foods were conducted in the second phase. The hysteresis studies for Phase II can best be described in the following three parts:

Part I

The first part was the hysteresis study of the compressed single foods. Seven of the eight selected foods were compressed at the pressure-dwell times listed in Table 3. Two sets of triplicate samples of each food were prepared. One set was equilibrated at 0% R.H. at 72° F., the second triplicate set equilibrated to 0% R.H. at 100° F. The set equilibrated to 0% R.H. at 72° F. temperature was then equilibrated at progressively higher relative humidities until reaching 75% R.H., at which point the food retraced the R.H. levels back to 0% R.H. The second set of samples, equilibrated at 100°, was equilibrated at succeedingly higher R.H. levels until reaching 32% R.H., at which level the foods were re-equilibrated in steps back to the initial 0% R.H.

Part II

This part of the hysteresis study was done with three groups of the compressed composition discs. In the first group, the P_1, P_2, and the uncompressed controls of apple-strawberry (Combination 8), cabbage and carrots (Combinations 6, 7), beef and spinach (Combination 3), spinach and eggs (Combination 4), and beef and eggs (Combination 2) were first equilibrated at 0% R.H. at 100° F. After reaching initial equilibrium, the R.H. solutions were then changed to the next higher relative humidity solution until reaching equilibrium at 32% R.H. from which point the relative humidity solutions were retraced to 0% R.H.

The second hysteresis study with combination foods was done with the P_2 compressed samples of beef and spinach (Combinations 1,3), beef and eggs (Combination 2), spinach and eggs (Combination 4), cabbage and carrots (Combination 7) and apples and strawberries (Combination 8). These samples were first equilibrated at 0% R.H. at 100° and then equilibrated at succeedingly higher R.H.'s until reaching 95%. From this level, the R.H. conditions were retraced to 0% R.H.

The P_2 compressed samples of apple-strawberry (Combination 8) and cabbage and carrots (Combination 7) were the two foods used in the third hysteresis study. These two composites were first equilibrated at 0% R.H. at 72° F. After equilibrium, the relative humidity conditions were raised stepwise to 75% R.H., fro.. which point the solutions were retraced stepwise until reaching the initial 0% R.H.

Part III

The P_2 compressions of combination discs 7 and 8 mentioned above were also used for the third hysteresis study. For this test, three groups of six disc samples each were initially equilibrated at three R.H.'s -- 3.0%, 11.1%, and 20.4% -- all at 100° F. After reaching equilibrium at the respective R.H., three samples were then equilibrated at 32% R.H. and three samples at 0%. After reaching equilibrium at these two levels, the samples were then equilibrated back to the respective initial relative humidities.

Hysteresis tests are summarized in flow sheet form in Figures I, II, and III. All hysteresis samples were made in triplicate with the exception of the second series in Part II.

2. Rate of attainment of equilibrium

Three discs of each pressure-dwell level for all the eight dual combinations were prepared for each R.H. level for the rate of attainment studies. These samples, along with uncompressed control samples, were equilibrated at the specific humidity levels and at two temperatures, 72° and 100° F. The samples were weighed at three storage intervals and then, if necessary, more frequently until equilibrium was reached (± 0.04% moisture change per five days).

3. Moisture sorption apparatus

The method for determining moisture content equilibrium relative humidity isotherms followed the technique first proposed by Wink (Ind. Eng. Chem. Anal. Ed., 18, 251 - 252) and modified by Levine and Fagerson [TAPPI, 37, (7), 299] with the exception of the size of the sample and the design of the sample holder. The humidity jars were the pint canning jars identical to the ones used in Phase I. A 1/4" hole was drilled in the center of the two-piece jar lids (Ball Bros.) to allow passage of a thin wire (22 AWG) approximately four inches long. The lower end of the wire in the jar is connected to a plastic dish for support of the compressed food sample and the outer upper end is looped to permit hanging from a balance hook. In the outer assembly, the wire passes through a rubber gasket which seals off the 1/4" hole. This gasket also serves in the positioning of the suspended food sample and to prevent its contact with the humidifying solution in the jar. The pan assembly from a model 40700A Mettler balance was removed and replaced by an equal weight of lead with an embedded hook. To do the weighing, the pint

jar assembly is placed under the leaded balance hook. The support wire is suspended from the balance hook so the sample swings freely. This procedure permits rapid weighing and minimizes any error from sample sorption or desorption during weighing.

The aluminum rings which contained the compressed single food samples in Phase I studies were cut from 1 7/16" diameter tubing. The compressed sample weight contained in these holders was from 9 - 15 grams. It was mentioned earlier that any component food that went into making the compressed composite sample should be present in noticeable quantities. Preliminary results with the 1 7/16" diameter holder revealed that a larger container was necessary if ideal quantities were to be weighed and present in each sample. To accommodate the sample weight of 20 - 25 grams, the holders used for the Phase II studies were 3/4" long rings cut from 2" diameter aluminum tubing. The foods were compressed in these rings and placed on plastic supporting dishes which in turn were fastened to the suspended wire. Figure IV illustrates the complete jar assembly and components. Figure V illustrates the use of the Mettler balance for direct weighing of samples.

Anhydrous magnesium perchlorate was used in test jars maintained at 0% R.H. Saturated salt solutions were used to control relative humidities of the other jar atmospheres with the exception of the 3% level, which was a solution of sulfuric acid. As mentioned in Phase I, saturated salt solutions were preferred wherever possible, since absorption or desorption of moisture from the test sample could alter the concentration of sulfuric acid solutions. Table 4 lists the salts used and the corresponding relative humidity levels at 72° F. and 100° F.

In the initial stages, daily checks were made on all jars to assure saturated salt conditions. The sulfuric acid solution in the 3% R.H. jars was changed weekly with fresh solution to eliminate possible changes in concentration resulting from moisture sorption.

4. Sample preparation procedures

The compressed disc samples were prepared by a team of three people working as rapidly as possible. Individual foods were weighed to the nearest 0.01 gram, combined and mixed well, loaded into the die and the specified pressure-dwell applied. A standard Carver laboratory hydraulic press, fitted with a supplementary low range pressure gauge was used to compress the samples. It was mentioned earlier that the food was compressed and left in 2" diameter aluminum rings. To produce this compressed ring, the piston of a standard 2" die was reduced to fit inside the aluminum ring, placed in the lower end of the female die. The mixed food samples can then be placed within the ring in the die and compressed. Figure VI illustrates the die used for compressing samples.

For the rate of attainment studies, the aluminum tube sections, the plastic dish and the wire supports had been previous tared. The ring and support assembly had been allowed to equilibrate at the initial relative humidity in the jar for one week before recording the tare weights. The aluminum ring holder was removed, the food compressed within it, and the unit reassembled. The assembled unit was then placed in the respective jar containing the humidifying solution and the initial sample weight was recorded. Sample preparation procedures for the hysteresis samples were the same. The samples to be used in storage stability analyses were left in the aluminum sections, but were stored in bulk in sealed glass fishbowls (Figure VII). Jars holding the appropriate solution for humidity regulation were placed in the bowls. The individual samples within the jar were kept separated by pieces of aluminum screen to promote uniform humidity and moisture adsorption conditions.

Sufficient disc samples were produced and stored in this manner to allow for chemical and rehydration evaluation at the three storage intervals. It was thought that a more meaningful evaluation of possible organoleptic changes could be made if a direct comparison of the storage samples was made at one time. Sample preparation, therefore, for organoleptic evaluations was staggered so that all the storage intervals ended at the same time.

C. Storage stability analytical procedures

1. Chemical tests

At least two chemical tests to determine storage deterioration characteristics were performed on each of the eight combination foods. These tests were done on foods stored at six different relative humidity conditions at 100° F. and at the end of three storage intervals.

The chemical analyses selected to evaluate storage stability on the various combinations are listed in Table 5. These tests were selected on the applicability to practical and available sample quantities as well as their applicability to the type of deterioration anticipated.

The quantitative determination of malonaldehyde (TBA test) was selected as one of the tests to determine storage deterioration for all lipid-containing compositions (beef and egg combinations). Attempts to analyze for free fatty acids and peroxide values in solvent extracts of the spinach-eggs and the two spinach-beef combinations revealed that the chlorophyll pigment extracted along with the lipids interfered with the end point in the determinations. It was additionally thought that by running the TBA test on all lipid-containing samples, comparison of possible component and composition effects could be made.

With some minor changes, the following analytical procedures were followed:

a. Anthocyanin pigments

The extraction and quantitative measurement of the anthocyanin pigments basically followed the procedures of Sondheimer and Kertesz (3). Best results have been obtained by blending 1.6 grams of dry material with 100 ml Sorensen's citrate - hydrochloric acid buffer and 25 mg Pectinol 10-M (Rohm & Haas, Inc., Philadelphia, Pennsylvania) in a Waring Blendor for two minutes. The sides of the Blendor jar were then washed down with 32 ml buffer and blending continued for two more minutes. The mixture was centrifuged at 2,000 rpm for 30 minutes. The clear supernatent extract was decanted and the concentration of anthocyanin pigments determined as specified by Sondheimer and Kertesz using a Beckman DU Spectrophotometer. Results were expressed as mg percent Congo Red. Duplicate determinations were made on each disc.

b. Ascorbic acid

The rapid method for the determination of ascorbic acid in fresh, frozen and dehydrated fruits and vegetables described by Loeffler & Ponting [Ind. Eng. Chem. Anal. Edit. 14: 846-849 (1942)] was used to follow changes in ascorbic acid content. After grinding the sample through a Wiley mill, the sample was mixed with 250 ml of 0.4% oxalic acid solution in a Waring Blendor for 3 minutes. This solution was filtered first through a small milk filter followed by a second filtration through #42 Whitman filter paper. Absorbancy readings on this filtrate were done using a Bausch and Lomb Spectronic 20 colorimeter.

c. Carotene

The chromatographic separation method for dried foods outlined in the AOAC (Ninth Edition, 1960) was used for the carotene analysis. Depending on the quantity of carotene present, one to fifteen grams of the food sample were used for the analysis and the results were expressed as micrograms of beta-carotene per gram of sample.

d. Free fatty acid

With the exception of the volume of oil being smaller, the method described under CA 5a-40 (1963) in the official methods of the AOCS (4) for free fatty acid determination was performed on an aliquot from a chloroform extraction. Because of the small amount of sample, 0.01 N sodium hydroxide was used in place of the standard 0.1 N base for titrating to the specified end point. It was noted that beef lipids clouded at the end point, but it is assumed that this does not interfere with the validity of the analysis.

e. Reflectance

Color changes indicative of "browning reactions" were obtained by running the reflectance spectra of homogeneously ground samples. Where anthocyanin or carotenoid pigments were extracted, the spectra were determined on the residue remaining after the pigment extraction. A Perkins-Elmer Recording Spectrachord equipped for reflectance measurement was calibrated to read 100% reflectance using a magnesium carbonate reference. Changes at specific wave lengths or within important wave length ranges were noted.

f. Thiobarbituric acid

The distillation method for the quantitative determination of malonaldehyde in rancid foods, described by Tarladgis et al (5), was the procedure used to determine lipid deterioration. One modification to the procedure was that the samples were ground and placed, dry, into the Kjeldahl flask. 30 ml of water was added and the sample allowed to rehydrate before distilling. Distillation was controlled to produce 50 ml of distillate in 10 minutes. 5 ml of the collected distillate was boiled 35 minutes with the thiobarbituric acid (0.02 M) solution in 90% glacial acetic acid for color production. Absorbancy readings on the cooled sample were run on the Beckman DU at 538 mμ with the slot set at 0.199 mm. Mg of malonaldehyde were calculated from a standard curve made from 1, 1, 3, 3, tetra-ethoxypropane.

2. Organoleptic evaluations

As mentioned earlier, the sample preparation for subsequent organoleptic evaluations were programmed so that all storage periods ended at the same time. Although there is the disadvantage of submitting too many foods to the panel at one time, it was felt that the panel's memory would be better over a period of a few days than over a range of three to four months.

From a pool of 20 people, eight to ten tasters were selected for the panel. The selection of the panel members was based on similarity in scoring and individual ability to duplicate results closely and, to some extent, their willingness to accept and evaluate foods in different forms and uncommon combinations.

During the several-day interval required for taste-testing, the panel members met in the panel room (Figure VIII) at 10 a.m. and 3 p.m. Two sets of four samples each were served at each session. The lighting during the sessions was subdued to minimize visual influence on judgment.

Coded samples were presented to the panel members and individual results were recorded on the sample ballots shown in Figure IX. Flavor and odor evaluations were rated on a hedonic scale, from 9 for the "extremely like" category to 1 for the "extremely dislike." Sample presentation commenced with the serving of the uncompressed control samples held for the three storage periods at the various relative humidities followed by the lower and higher compressed storage samples.

With the two exceptions of strawberry-apple and cabbage-carrots combinations, all food samples presented to the panel were moistened with 160° F. water for greater acceptance and taste discernment. Preliminary taste tests with dry and moistened strawberry-apple samples revealed that the dry form was more acceptable. The cabbage-carrot combinations absorbed water unevenly and were served dry for uniformity of presentation.

The results of the taste panel were statistically analyzed as a split plot experiment on the supposition that the experimental error might be significantly larger than the error of evaluation.

3. Rehydratability tests

The rehydration characteristics after three storage periods of the eight combinations were analyzed by soaking in an excess of water at room temperature. Discs were kept submerged and agitation was limited to occasional probing to note progress. The results of these tests are expressed as time required for disintegration and/or appearance of complete hydration.

III. RESULTS AND DISCUSSION

A. Moisture sorption studies

1. Hysteresis

The complete data from the hysteresis studies is not available at this time since many of the equilibrations are taking longer than anticipated. Rather than include partial and incomplete results with this report, a supplementary report covering the results and analysis of all hysteresis studies will be submitted as soon as possible after all the data is available.

2. Moisture sorption isotherms

The rates of attainment and final equilibrium moisture contents of the combination foods are listed in Tables 6 through 21. Figures X through XXV show isotherms plotted from the final equilibrium moistures.

Specific comparisons of the rate of attainment cannot be made, but generally the combinations containing beef and eggs equilibrated within a month, while the cabbage-carrot and apple-strawberry mixtures took slightly longer to equilibrate.

It should be mentioned here that some of the isotherms are drawn from the data obtained by vacuum oven solids determinations (16 hours at 70° C.) after equilibrium had been reached. Originally, the rate of attainment and the equilibrium relative humidity (ERH) moisture contents were to be obtained by using the static equilibrium method described in Phase I of this contract. Briefly in review, the procedure involves the direct weighings of a food sample of known initial moisture content maintained in humidified air. The selection and regulation of relative humidity levels are achieved by the use of saturated salt solutions placed together with the samples in specially equipped jars.

In the first phase of work, several ERH moisture values obtained by the direct weighing method were rechecked by running vacuum oven solids determination on the equilibrated sample (16 hours at 70° C.). The results of these random checks agreed quite closely, indicating that the direct weighing results were reproducible by oven drying. Based on these earlier findings, it was the initial plan to follow this identical empirical procedure and report the ERH moisture contents based on the direct weighing method. However, the ERH moisture contents of several combination foods revealed that equilibration was not taking place at the anticipated levels based on Phase I single foods data. Vacuum oven solids determinations were then run on several randomly selected equilibrated samples to verify the results of the direct weighing method. From the comparison of the two results, further inconsistencies were noted and it was decided to run vacuum oven checks on all subsequently equilibrated samples. Wherever the vacuum oven determinations were made, the results are listed in the data tables as "moisture by analysis." It should be mentioned here that the vacuum oven results are averages of duplicate analyses on at least two of the three replicate samples equilibrated at each relative humidity.

It can be noted in tables that include oven solids analysis that the oven solids do not agree with the results calculated from weight changes. Rey and Bastian (6) also reported discrepancies between a "calculated from weight" curve and a direct analysis curve on orange juice stored at 40% R.H. In all instances except

for the beef-potato combination, the oven solids method indicated higher moisture content. This deviation was true regardless of whether equilibrium had been attained by adsorption or desorption.

To rule out the possibility that an error had been introduced by moisture sorption during the preparation of the individual discs, simulated runs were made. The results of these tests revealed that no significant moisture pick-up occurred during the 2 - 3 minutes preparation time. In addition, moisture contents of the component foods were rechecked with the thought that the initial moistures used in the calculation were in error. The results of these rechecks confirmed the initial moisture values and ruled out initial moisture contents as a source of error.

Possible explanations for the differences in ERH moisture contents between the two methods can include:

a. The formation of volatiles during storage and the subsequent loss of these volatiles on vacuum oven determinations. The negative malonaldehyde results indicate that this specific class of volatiles may have been lost.

b. The formation of water by deteriorative reactions and the subsequent loss of this fraction on equilibration with ambient moisture.

With the beef-potato combination, the vacuum oven results are consistently lower than the direct weighing values.

Because the potatoes used in the disc preparation were raised to a high initial moisture content and in an unstable range, no rechecks on initial moisture were possible. Initial moisture content cannot be ruled out as a source of error completely, even though careful procedures were followed in sample preparation. The results of the previously mentioned rechecks indicated that little sorption or desorption occurred during sample preparation, but in using potatoes with the high initial moisture content, greater desorption may have taken place during the preparation interval. Then too, the quantitative definition of moisture content is determined by the method of analysis and to some extent the nature and quantity of water present in the sample. Van Arsdel (7) points out that there are at least seven distinguishably different vacuum oven procedures, each giving different results from each other. For dehydrated potatoes, two drying times are noted, 6 hours and 40 hours. Because we used a 16-hour drying time on potato samples of varying moisture content mixed with beef, there exists the possibility that the drying period or the method was inadequate to give consistent results. It is not known why these differences occurred, and without any supporting data, further postulation is precluded.

Although the empirical results of the two methods differed, the final results by each method indicated that compression did not affect the ERH moisture contents.

In the case of apple-strawberries, the compressed samples appeared to equilibrate to higher values if weight change alone is used for the basis of comparison and confirms the findings of Phase I. Unfortunately, oven solids were not run with this combination for comparison of results.

Because several combinations containing a similar component equilibrated alike, the discussion of these combinations is under the heading of the similar component food. Some data will be duplicated in grouping the results, but variable combination and component effects can be better presented.

It should be mentioned that the replicate moisture analyses of the given samples agreed in the majority within the standard deviation for vacuum oven moisture analysis (± 0.2%). Therefore, no significance is given to differences between samples or treatments at given conditions unless they differed by more than 0.4%.

Beef combinations

Combination 1 - Beef-spinach (75% - 25%)
Combination 2 - Beef-eggs (50% - 50%)
Combination 3 - Beef-spinach (39% - 61%)
Combination 5 - Beef-potatoes (55% - 45%)

The ERH moisture contents of these four beef-containing combinations are summarized on Tables 22 and 23. These results are taken from the P_0 or control values of the respective individual combinations. Moisture sorption isotherms are shown in Figures XXIV and XXV. As in the case of the single foods, the samples equilibrated at 72° equilibrated to higher levels than the 100° samples. At both storage temperatures, compression did not have any effect on the ERH moisture contents.

No differences are noted between compressed and uncompressed and between the compression levels.

The 72° ERH moisture values show that three of the combinations (1, 2, and 3) equilibrated to similar values at 11.1% R.H., but equilibrated to different levels at other R.H. levels. The two beef-spinach combinations equilibrated to similar values at 3 and 11.1%. Potato-beef combinations showed consistently higher equilibrium moisture contents except at the higher R.H., where there appears to be a leveling off. Because several instances of mold contamination were experienced at 75.8% R.H., there is some doubt as to the validity of the results at this high R.H.

The ERH moisture contents of samples stored at 100° show again that beef and potatoes equilibrated to consistently higher values, reflecting the greater water-holding capacity of the potato component. The other three combinations equilibrated to approximately the same moisture values except at the 3% level where some greater divergence is noted. Based on the results of the two spinach-beef combinations, composition variable effects do not appear to affect the ERH moisture levels at 100°.

On both summary sheets, the ERH moisture results by the direct method of Phase I single uncompressed foods are listed on the right. As mentioned earlier, different lots of foods were used in each phase of work and some variations in results are to be expected. On the other hand, in both phases of work similar lots of foods were either purchased or prepared, the same freeze-drying procedures followed, and all foods were equilibrated in practically the same manner. Therefore, the inclusion of the single foods data serves as good a basis as any to illustrate the deviations from the anticipated moisture levels in the following discussion. At 100°, beef and spinach equilibrated to higher values than either beef or spinach alone. Several instances of this higher equilibration are noted in the beef-potato combinations (3%, 11.1% at 100°). The same results of the higher combination moisture values also occur in the lower ranges of the beef-spinach combination stored at 72°.

In several instances, the equilibration appears to be closer to the ERH values of one of the components. Beef and egg at 7% R.H. at 100° equilibrated to the same value as the egg, although it contained only 50% egg. At 3% R.H. and at 100° the value is slightly higher than eggs alone.

Possible explanations for the higher results of the combination food may be:

a. Swelling reaction of the disc resulting in greater moisture retention of either component.

b. Alterations of individual sorption behavior by the other component.

Spinach Combinations

Combination 1 - Spinach-beef (25% - 75%

Combination 3 - Spinach-beef (61% - 39'

Combination 4 - Spinach-eggs (25% - 75%)

The ERH moisture contents of the three spinach combinations are summarized on Tables 24 and 25. The moisture serption isotherms of these combinations are shown in Figures XXVI and XXVII. As noted earlier, the two spinach-beef combinations equilibrated to the same

levels at 100°. Spinach and eggs at 100° and at the lower R.H.'s equilibrated to lower values than spinach-beef, but at 7% and 11.1% R.H., all three combinations tend to equilibrate to the same level.

Component variable effects are attenuated at 100° storage and in the middle R.H. levels. The effect of component variables in Combinations 1 and 3 at 100° appear to be insignificant.

Spinach-eggs equilibrated at 100° and at 3 - 7% R.H. appears to equilibrate to the level of the Phase I ERH moisture level of eggs. It would appear from the above results that the ERH moisture content of the combination is not affected by the 25% spinach present. This apparent shift of equilibrium is also noted at 11.1% R.H. at 100° in Combination 1.

Compression effects between greater pressure differentials can be noted with the two spinach-beef samples. At 100° in the middle R.H. levels, compression does not affect the results. On the other hand, it is not known whether component or compression effects are responsible for the differences between the two spinach-beef combinations at 72° F.

Egg combinations

Combination 2 - Beef-eggs (50% - 50%)
Combination 4 - Spinach-eggs (25% - 75%)

The results of the two combinations containing eggs are summarized on Tables 26 and 27. Moisture sorption isotherms are given in Figures XXVIII and XXIX. Component variable effects are more noticeable at 72° storage although at 11.1% R.H. both compositions appear to equilibrate closely.

Component variables do not appear to produce consistent effects on the ERH moisture values. The most notable example is at 72° at 3% R.H., and to some extent at 11.1%, where beef-eggs equilibrated to lower levels than the spinach-eggs. Above 23% R.H., beef-eggs equilibrated to higher levels.

At 3% R.H. at 100°, both combinations equilibrated to values higher than Phase I individual foods.

As noted earlier, compression does not affect the ERH moisture levels. Component variables, on the other hand, affected the ERH moisture levels, since the same pressure treatments were used for both combinations with different results.

Cabbage-carrots

Combination 6 - (82% - 18%)
Combination 7 - (64% - 36%)

The complete vacuum oven analyses are not available for the 72° F. storage. The results of the two combination foods are summarized on Tables 16 through 19. Moisture sorption isotherms for the combinations at 100° are shown in Figure XXX.

Because of the slow gradual changes experienced in Phase I with dried cabbage, the storage periods were extended to four months for both these combinations.

The available vacuum oven results in both combinations and at both temperatures are in most instances higher than the results obtained by direct weighing.

Although complete vacuum oven solids data are not available, compression treatment did not produce any significant changes in ERH moisture content.

Both combinations at the upper and lower R.H. levels at 100° F. equilibrated to similar levels, while at 11.1% R.H. greater differences were noted.

Variable composition effects are most significant with samples equilibrated at 72°. Combination 6, containing a greater cabbage content, equilibrated to lower ERH levels than Combination 7.

Apple-strawberry

Combination 8 - (50% - 50%)

The ERH moisture values by the direct weighing method showed that compressed samples equilibrated to higher levels, but there was no difference between the two compression levels. 100° storage produced greater differences between uncompressed and compressed samples. ERH moisture contents are summarized on Tables 20 and 21. Moisture sorption isotherms are shown in Figures XXXI and XXXII.

B. Storage stability analysis

1. Chemical analysis

The results of the chemical analyses to determine storage stability of the eight combination foods are listed in Tables 28 through 46. For easier comparisons, some of the results are expressed as percent gain or loss from the initial control values.

In general, compression had very little effect on deterioration. Storage R.H. and time, on the other hand, were more significant. The results of the ascorbic acid, carotene and anthocyanin determinations reveal that at the lower R.H. less losses occurred. Rapid deterioration was noted for ascorbic acid even at 0% R.H. and an increasing rate of deterioration on successive increases in R.H. The results of the malonaldehyde and free fatty acid analyses, on the other hand, show greater deterioration at the lower R.H. levels. While free fatty acid formation was lowest in the 7% and 11% R.H. range with the beef-potato combination, there was no other indication of an optimum R.H. range or monolayer value that was beneficial for maximum storage stability.

The results of the malonaldehyde determinations showed several instances of losses instead of expected gains. Beef and spinach combinations all showed losses in malonaldehyde, whereas spinach and egg showed gains. Beef-eggs and beef-potatoes showed both losses and gains. As mentioned earlier, the selection of the TBA method was necessitated by the impossibility of obtaining colorless lipid extracts from combinations containing spinach. By applying the TBA method to all lipid-containing combinations, we had hoped to study component variable effects as well as to quantify lipid deterioration. It appears also that combination effects play a part in this unknown volatile evolution; with beef-spinach, the results were all negative, while with spinach-egg the results were all positive. Apparently there is some interfering volatile evolution or reaction involved, resulting in the negative values. It could be that the malonaldehyde itself is lost or takes part in other reactions during storage.

As a result of the negative malonaldehyde values, it is difficult to compare and quantify lipid deterioration, but the comparative effects of R.H. and compression on the results will be noted.

The results of the reflectance analyses run in the manner outlined earlier did not produce any consistent interpretable results. The storage R.H. and time appeared to affect the reflectance values more than the compression, but in no set manner. The selection of several wave lengths for reflectance measurements did not produce the anticipated results that would measure specific color changes.

Combination #1 - Beet-spinach (75% - 25%)

Results of the chemical analyses are shown on Tables 28 through 30.

a. Ascorbic acid

The loss of ascorbic acid is rapid and the percentage of loss is directly related to the storage relative humidity. The fact that after one month at 0% R.H., the control samples lost over 50% indicates that factors other than R.H. are involved in ascorbic acid stability. Increasing the storage R.H. from 0% to 31.9% resulted in a 20% greater loss after one month and almost a total loss (90%) after two months storage at this high humidity.

The P_1 and P_2 values were nearly the same as P_0 values, indicating that compression did not have any enhancing or detrimental effects on ascorbic acid stability.

b. Beta-carotene

The greatest loss of beta-carotene occurred during the first month of storage. Deterioration continued in the second month, but at a lower rate. The relatively little increase in loss between the second and third months at 0, 3, and 7% R.H. might indicate that further carotene deterioration is inhibited at these R.H.'s.

Higher storage R.H.'s did not retard the deterioration of carotene, for additional losses are noted after three months at 20.4% and 31.9% R.H.

The results of compressed and uncompressed samples show only slight difference, indicating that compression had no adverse or beneficial value.

c. Malonaldehyde

The results obtained were all negative, and as mentioned earlier, it is difficult to relate these results to lipid deterioration. If the amount of malonaldehyde present is an indication of deterioration or rancid conditions, then the samples stored at the lower R.H. levels should be considered less acceptable than those at the higher R.H. levels. The values of all R.H. levels then tend to separate into three distinct groups at the end of three months.

The results of the compressed and uncompressed samples, though not consistent, appear to indicate that compression had no effect on the results.

c. Reflectance

There was a general trend for the samples to get lighter during three months of storage. The relative humidity levels did not seem to have a significant effect, but pressure did show a definite effect during storage. While the compressed samples became lighter during storage, the uncompressed became darker. In comparison between the compressed samples, the higher compression made the samples show lighter results.

Combination #2 - Beef-egg (50% - 50%)

The results of the analyses performed on this combination are summarized on Tables 31 and 32.

a. Beta-carotene

As shown in the tabulated results on Table 31, beta-carotene follows the trends noted in the beef-spinach combinations. The initial storage periods showed the greatest loss followed by losses at a lower rate. Samples compressed at the higher levels showed lower values, indicating that compression may have some minor beneficial effect.

The lower losses at the lower R.H. indicate that deterioration is affected by storage R.H.

b. Malonaldehyde

It should be noted that some of the results were negative and these generally occurred at the higher R.H.'s.

Storage at 0, 3, and 7% R.H. resulted in greatest malonaldehyde formation and at the end of three months the 0% storage R.H. showed the greatest amount formed.

The higher R.H.'s retarded but did not inhibit malonaldehyde formation, as evidenced by the increase during the one to three months storage.

The higher compression level appeared to have some beneficial effect, especially at the lower R.H. levels and after three months, where greater malonaldehyde formation occurred.

c. Reflectance

Although there was quite a variation in results, there was a general trend for the samples to become darker during the first two periods of storage, then there appeared to be some reverse reaction during the third month of storage which made the samples lighter than before storage. The extreme levels of R.H. of 0% and 32% showed the least amount of change during storage and pressure treatments did not show any effect on the results.

Combination #3 - Beef-spinach (39% - 61%)

The four analyses run on this combination are shown on Tables 33 through 35.

a. Ascorbic acid
As noted with Combination #1, ascorbic acid deterioration is rapid, and this beef-spinach combination is no different; only 50% of the original ascorbic acid remained after one month storage. And as mentioned earlier, increasing the R.H. level greatly enhances the deterioration rate. The effects of compression did not exert any beneficial or detrimental effects on ascorbic acid retention.

b. Beta-carotene
The greatest percentage of loss occurred during the first month. Subsequent losses were less and the losses between the second and third month showed the smallest increase.

The effect of R.H. does not appear to affect the deterioration rate too greatly in the first month, but the cumulative effects of time and higher R.H. level resulted in further carotene losses at the end of three months.

Results of the compressed samples were not significantly different from the uncompressed, indicating that compression had little effect on the results.

c. Malonaldehyde
As noted earlier, there was a loss in malonaldehyde instead of an expected gain on progressive storage. The results, from a numerical standpoint, indicate that the R.H. range from 3% to 11.1% produces some action, either protective or detrimental, during the storage periods. The values after the first month at 3 - 11.1% R.H. remained fairly constant, indicating that lower R.H.'s may inhibit or retard the reactions taking place.

The difference between compressed and uncompressed and between the compression levels reveals that compression treatments do not have any effect on the outcome of results.

d. Reflectance
In contrast to Combination #1, these samples become progressively darker with increased storage, but the increased relative humidity did not show any significant effect. Although the results varied, pressure did not seem to affect the samples, except that there seemed to be some reversible reactions during the second month.

Combination #4 - Spinach-eggs (25% - 75%)

Results of the analyses performed on this combination are summarized on Tables 36 through 38.

a. Ascorbic acid

The destruction of ascorbic acid in this combination follows the pattern of the other spinach combinations. At the end of one month storage, there was again approximately 50% loss at 0% R.H. and this destruction became progressively greater with increasing R.H.

The results of compressed and uncompressed samples indicated no beneficial or adverse effects on ascorbic acid retention by comparison.

b. Carotene

Carotenoid losses increased with progressively longer storage period, and increasing R.H. does not appear to have an accelerating effect. The effect of storage time and R.H. is cumulative, as noted at the 31.9% R.H. after three months, which showed the greatest loss.

Compression does not affect carotene retention in the early storage stage, but at the end of the three month storage period the higher compression levels appeared to exert a very slight retentive action.

c. Malonaldehyde

The results indicate that malonaldehyde content increases with storage, indicating that lipid deterioration is taking place. The greatest deterioration occurred at 0% R.H., and deterioration decreased with increasing storage R.H. High R.H. conditions apparently result in lower malonaldehyde production.

Malonaldehyde production was also affected by the two pressure treatments. The values between pressure levels and between compressed and uncompressed samples reveal the beneficial effects of compression. The results show that some compression is better than none, and the higher the compression level the greater the beneficial effect.

d. Reflectance

These residues became significantly lighter during the first month of storage and then became darker during the two succeeding months of storage; during the second month of storage there appeared to be a reverse reaction which made some of the residues even darker than they were initially, and they appeared to get lighter again during the third month. Relative humidity seems to make differences, but in no set pattern. Pressure had little effect except that there appeared to be a greater amount of change in the compressed samples during storage.

Combination #5 - Beef-potatoes (55% - 45%)

The results of the three tests for storage stability for this combination are on Tables 39 and 40.

a. Free fatty acid

The free fatty acid values of all the one month storage samples are, for the most part, identical, indicating pressure and R.H. had no effect on free fatty acid formation. During the second and third months, increases in free fatty acids are noted at the 0% and 31.9% R.H. levels. The values in the middle R.H. ranges remained fairly constant, indicating that extremely low and high R.H. increases formation of free fatty acid.

The results of compression indicate that, for the most part, compression treatments did not have any significant effects on free fatty acid formation.

b. Malonaldehyde

In the first month, the greatest amount of malonaldehyde produced was at 0% R.H. and the least at 31.9%. Additional gain in malonaldehyde at the lower R.H.'s occurred at the end of two months, and apparent losses were noted at the higher R.H.'s. Nearly all the samples at all R.H.'s were negative after three months, precluding further conclusions.

Although it is not known what occurs during the three intervals, compression did not have any noticeable effect on the results.

c. Reflectance

Pressure had little effect on these samples, but the different R.H. levels had a definite effect. The samples stored at 0% R.H. showed a small change in the samples, becoming darker. This level of darkness remained somewhat constant for the remaining months of storage. Samples stored at the two highest levels of R.H., 25% and 32%, got darker but reached their darkest level during the second month of storage and went back to about the same level during the third month as they had been during the first month of storage. Samples stored at the middle levels of R.H. got darker progressively through the second month, but during the third month they appeared to be lighter than they were initially.

Combination #6 - Cabbage-carrots (82% - 18%)

Combination #7 - Cabbage-carrots (64% - 36%)

The results of the analyses on these two combinations are shown on Tables 41 through 44. Because of similarities in results, these two combinations are discussed together.

a. Ascorbic acid

Ascorbic acid losses were lowest at the lower storage R.H., and greater losses occurred with increasing storage R.H. With Combination #7, the compressed samples lost more ascorbic acid than the uncompressed controls at higher storage R.H. Compressed samples of Combination #6 also exhibited some evidence of greater ascorbic acid destruction over uncompressed at the higher storage R.H.'s. From the available data there appears to be no consistent effect of compression on ascorbic acid retention.

b. Carotene

The freeze-dried carrots had bleached to a very light color even before compression. The loss in color was not uniform, for an occasional deeper-colored piece could be seen in the stored compressed discs during preparation for extraction. In spite of thorough blending, some of the discs included the occasional darker pieces, which affected the results.

In view of the above, it is not possible to draw confident conclusions from the data. Based on the available data, it appears that one-half of the carotene is lost on two months storage.

c. Reflectance

Both combinations grew progressively darker with increased storage and R.H. levels. The greatest darkening occurred during the fourth month of storage. Some variations in degree of darkening occurred with the compressed samples, but generally the differences between compressed and uncompressed samples were small, and compression cannot be considered a significant factor.

Combination #8 - Strawberry-apple (50% - 50%)

Results of the chemical analyses for this combination are on Tables 45 and 46.

a. Ascorbic acid

Ascorbic acid destruction increased with progressive increases in R.H., as experienced with the other combinations. The limited data available indicates that the rate of ascorbic acid destruction is not affected by the compression treatments. The storage R.H., on the other hand, had an accelerating effect on the rate of destruction.

b. Anthocyanin pigments

The results indicated that degradation increased with storage R.H.; but the best storage humidity appears to be 3%. After one month storage, compression does not appear to exert any influence on the results, while at the end of three months,

compressed samples in the middle R.H. levels showed greater retention of anthocyanin pigment. Samples stored at 31.9% after three months showed that the beneficial effects of compression were overcome by the high storage R.H.

c. Reflectance

The residues became darker with storage, but the different R.H. levels had a definite effect on the rate and the degree. At the higher levels of 21.4% and 31.9%, the residues appeared to develop a degree of darkness that remained more or less constant during the remaining two months of storage. The residues from the other R.H. levels appeared to be the lighter during the second month of storage, showing some reversible reaction. Compression seemed to show a greater degree of change in the lower R.H. levels, but had no effect at the higher levels of 31.9% and 21.4%.

2. Organoleptic analysis

In evaluating the results of the taste panel, it should be remembered that where the mean squares for the treatments is not significantly larger than the Taster x Treatment mean squares, the conclusions drawn by this panel might be different than conclusions drawn by another panel evaluating the same material.

As expected, some combinations were more acceptable than others. Listed below are means of the hedonic scale ratings for each food combination:

Food Combination and %	Flavor	Odor
Beef-spinach (75/25)	6.3	6.2
Beef-eggs (50/50)	6.3	6.2
Beef-spinach (39/61)	6.1	6.2
Spinach-eggs (25/75)	6.4	6.1
Beef-potatoes (55/45)	6.4	6.4
Cabbage-carrots (82/18)	5.0	5.3
Cabbage-carrots (64/36)	5.1	5.2
Apples-strawberries (50/50)	6.5	6.4

The cabbage-carrot combinations were rated the poorest by the panel, while the apple-strawberry combination was rated the best. Close behind the apple-strawberry were beef-potatoes, spinach-eggs, beef-spinach (75/25), beef-eggs, and beef-spinach (39/61). The 75/25 combination of beef and spinach was rated slightly higher than the 39/61 combination, probably because it had more beef.

For combinations containing similar components, there does not appear to be any correlation between flavor and odor.

Among the four combinations containing beef, the beef-potatoes combination scored the highest, although not by any large margin. With the combinations containing spinach, the spinach-egg combination scored higher than the two beef-spinach mixtures.

In the following paragraphs, some of the more salient effects of compression, storage R.H., storage period, and combination variables on acceptability are presented. Following this discussion is the interpretation of the organoleptic evaluations of each of the eight food combinations.

a. Effects of compression vs. uncompressed

The effect of compression on acceptance varied with the different types of combinations.

The compressed beef combinations were preferred over the uncompressed combinations with the exception of the beef-egg combination. The beef-spinach combination with the higher beef content showed the greatest effect of compression. For both beef-spinach combinations, the order of increasing acceptance was the same: P_0, P_2, and P_1, indicating a favorable compression level.

The effect of compression on the beef-egg and spinach-egg combinations was slight, but the highest compression level resulted in the poorest ratings; high compression with these combinations appears to have some undesirable effects.

The evaluation of compression effects on acceptance with combinations containing spinach was not possible. Acceptability was markedly influenced by the component foods, and these component variables obscured comparison of compression variables.

The panel showed a slight preference for the uncompressed samples of both cabbage-carrot combinations except for samples stored for four months.

The results of compression on the strawberry-apple combination revealed that acceptance was adversely affected by pressure treatments.

b. Storage effects

The storage periods brought about several interesting effects depending upon the particular combination. There was not a general decline in acceptance with increase in storage period, but there were isolated cases where this was true and this is discussed below. The effects of storage period, however, varied with the R.H. and compression.

The acceptance of all of the beef combinations followed the same pattern with some deviations:

There was an increase in acceptance up to one month storage and a drop at three months storage, with some variations due to R.H. (the higher levels of R.H. tended to show more deterioration over storage). The beef-spinach combinations were affected the most by storage, the beef-potato combination the least.

Both beef and spinach combinations reacted to storage in much the same manner, in that there was an increase in acceptance at one month storage followed by a decrease in acceptance at two and three months with some variations due to R.H. The stored 31/69 beef-spinach combination dropped below the initial control samples in acceptance, whereas the 75/25 combination dropped to the same level as the control samples. The 75/25 beef-spinach combination was more acceptable than the 31/69 combination after the storage period.

The effect of storage on the spinach-egg combinations varied with compression treatment, whereas the effect of storage on the beef-egg combinations varied with R.H.; therefore, storage effects with the egg combinations cannot really be compared due to different interactions. The same can be said for the spinach combinations.

The 64/36 cabbage-carrot combination showed the effect of storage more than the 82/18 combination. The results of both combinations were somewhat similar in that storage made the samples more palatable, but there were some variations due to compression.

There was little or no statistically significant effect of storage on the apple-strawberry combination although the means of the hedonic ratings did decline with increase in storage.

c. Effect of relative humidity

Generally speaking, samples stored at the three highest R.H. levels were scored lower in acceptance than the three lower R.H. levels, but there were variations due to the cumulative effects of compression and storage period.

All of the beef combinations followed the general trend, but with variations due to storage period (the higher levels of R.H. tended to show less acceptability after storage). The beef-spinach combinations were affected most by the cumulative effects of storage and R.H., and the beef-potato combination the least.

The two beef-spinach combinations followed the same pattern with respect to the effect of R.H., with some deviations. The 61/39 beef-spinach combination lost acceptance at the 20.4% level, whereas the 75/25 beef-spinach combination was less affected by high storage R.H.

The effect of R.H. on the spinach-egg and beef-egg combinations varied with compression and storage period respectively. Both the egg combinations cannot really be compared compression-wise, due to different interactions, and the same can be said for the three spinach combinations.

The 82/18 cabbage-carrot combination showed the effect of R.H. less than the 64/36 combination, although both were somewhat similar. The panel exhibited greater acceptance at the lower R.H. levels (there were some variations due to compression).

The apple-strawberry combination followed the general trend with a decrease in hedonic ratings as the R.H. level increased (the effect of R.H. varied with compression). The R.H. effect was particularly noticeable at the 31.9% level.

Combination #1 - Beef-spinach (75% - 25%)

The statistical analysis of the taste panel results for beef-spinach (Combination #1) discs are given in Tables 47 and 48. The consensus of the panel members was that all the treatment effects were highly significant. The following interactions existed, however: Flavor -- R.H. x Storage Period, significant (Table 49); Storage Period x Compression, highly significant (Table 51). Odor -- R.H. x Storage Period and Storage Period x Compression, highly significant (Tables 50 and 52).

The samples stored at the 0%, 3.0%, 7.0%, 11.1% and 31.9% R.H. levels appeared to gain in acceptance and then drop off as the storage period increased. The 11.1%, 20.4% and 31.9% R.H. levels seem to be scored lower at the various storage intervals than the other R.H. levels (Tables 49 and 50).

It looks as though the P_1 samples are preferred over the other compression levels, the degree depending upon the storage level (Tables 51 and 52).

These results should be tempered with the knowledge that the following taster interactions were found: Flavor -- all Taster x Treatment interactions, highly significant. Odor -- Taster x Storage Period and Taster x Compression, highly significant; Taster x R.H., significant.

Combination #2 - Beef-eggs (50% - 50%)

The results of the statistical analysis and the taste panel evaluation of the beef-egg discs are given in Tables 53 and 54. The panel concluded that there were highly significant flavor and odor differences due to storage period and relative humidity. A significant interaction existed between these two effects (Tables 55 and 56). Samples stored at 0%, 3.0%, 7.0%, 11.1% and 20.4% R.H. appeared to gain in acceptance up to one month storage and then drop off after three months storage. The samples stored at 31.9% R.H. seemed to be less acceptable as the storage period increased.

The analysis of variance of the organoleptic evaluations revealed a highly significant odor difference due to compression not evident flavor-wise. There was a highly significant Storage Period x Compression interaction for odor (Table 57). The uncompressed samples seemed to be relatively unaffected by storage period. The compressed samples appeared to increase in acceptability to one month and then drop at three months.

These results should be tempered with the fact that the following taster interactions were found: Flavor -- Tasters x R.H., significant; Tasters x Storage Period, highly significant. Odor -- Tasters x R.H., significant; Tasters x Storage Period, highly significant; Tasters x Compression, significant.

Combination #3 - Beef-spinach (39% - 61%)

The statistical evaluation of the organoleptic results for beef-spinach (#3) discs are given in Tables 58 and 59. The panel members concluded that the storage period and R.H. effects were highly significant. There was no significant interaction between these two effects. The means of the hedonic scale ratings for relative humidity are as follows:

Relative Humidity (%)	Flavor	Odor
0	6.4	6.3
3.0	6.3	6.4
7.0	6.4	6.5
11.1	5.9	6.3
20.4	5.6	5.9
31.9	5.7	6.0

There appeared to be a loss of acceptance for the beef and spinach combination (#3) as the percent relative humidity at which the samples were stored increased.

The means of the taste panel evaluations for storage period are as follows:

Storage Period (Mo.)	Flavor	Odor
0	5.9	6.1
1	6.5	6.5
2	6.2	6.5
3	5.6	5.9

The stored samples seem to gain in acceptance and then drop off as the storage period increased.

The compression levels were found to have significantly different effects on the samples flavor-wise, but evidenced no significant effect on odor. The means of the hedonic scale ratings for compression are as follows:

Compression Level	Flavor	Odor
P_0	6.0	6.2
P_1	6.2	6.3
P_2	5.9	6.2

The P_1 samples appear to be preferred over the other compression levels.

These results should be tempered with the knowledge that there were highly significant interactions between the tasters and all of the treatments.

Combination #4 - Spinach-eggs (25% - 75%)

The statistical calculations for the organoleptic evaluation of the spinach-egg discs are given in Tables 60 and 61. The tasters concluded that there were highly significant flavor and odor differences due to R.H. The effect of storage period on flavor and odor was significant and highly significant respectively. There was no significant interaction between these two effects. The means of the hedonic scale ratings for relative humidity are as follows:

Relative Humidity (%)	Flavor*	Odor
0	6.5	6.3
3.0	6.4	6.2
7.0	6.6	6.3
11.1	6.3	6.3
20.4	6.2	6.0
31.9	6.1	5.9

* Interaction (R.H. x Compression)

The panel apparently detected an adverse effect on the odor of the samples at 20.4 and 21.9% R.H. storage. (Flavor is discussed below.)

Although there was no significant effect of compression on the food, there was a highly significant Compression x R.H. interaction for flavor (there was no such interaction for odor). Referring to Table 62, it appears that the R.H. levels from 11.1% on have an increasingly detrimental effect on the flavor of the food, the degree depending on the level of compression.

A highly significant interaction existed between storage period and compression for both flavor and odor (Tables 63 and 64). The effect of storage period varied with compression level. The P_1 and P_2 samples look as though they gained in acceptance at one month storage and then dropped off at two and three months storage.

These results should be tempered with the fact that the following taster interactions were found: Flavor -- all Taster x Treatment interactions were highly significant. Odor -- Tasters x R.H. and Tasters x Storage Period, highly significant.

Combination #5 - Beef-potatoes (55% - 45%)

The results of the statistical analysis of the taste panel evaluation of beef-potato discs are given in Tables 65 and 66. The panel concluded that there were highly significant flavor and odor differences due to compression and storage period. The effect of R.H., on the other hand, was not found to be significant. The following interactions existed: Flavor -- R.H. x Storage Period, significant; Storage Period x Compression, highly significant (Tables 67 and 69). Odor -- R.H. x Storage Period and Storage Period x Compression, highly significant (Tables 68 and 70).

The panel appears to have scored the stored samples higher than the control (0 months) samples, although this varied with the R.H. level in no significant pattern (Tables 67, 68).

The order in which the compression levels were scored varied with the storage period (Tables 69, 70). The flavor of the compressed samples appears to be better than that of the uncompressed samples. On the other hand, the odor of P_1 seems to be scored lower than that of P_0 and P_2.

These results should be tempered with the fact that the following taster interactions were found: Flavor -- Tasters x R.H., significant; Tasters x Storage Period and Tasters x Compression, highly significant. Odor -- Tasters x Storage Period and Tasters x Compression, highly significant.

Combination #6 - Cabbage-carrot (82% - 18%)

The statistical analysis of the taste panel results for cabbage-carrot (#6) discs are given in Tables 71 and 72. The consensus of

the panel members was that all of the treatment effects were highly significant for flavor, but only the effects of storage period were significant (highly) for odor. The following interactions existed: Flavor -- R.H. x Storage Period and Storage Period x Compression, highly significant (Tables 73, 74). Odor -- Storage Period x Compression, highly significant (Table 75).

The effect of relative humidity varied with storage (Table 73). It appears that the quality of the samples declined with increased R.H. level, depending on the storage period. There seemed to be an inconsistent rise in the ratings as the storage period increased for all R.H. levels except the highest, where the stored samples were scored lower than the control samples.

Regarding Table 74, it looks as though the uncompressed material was preferred over the compressed material except for the four months storage samples. Table 75 shows an apparent increase in acceptability for odor as the storage period increases, except for the uncompressed samples.

These results should be tempered with the fact that the following taster interactions were found. Flavor -- Tasters x R.H. and Tasters x Storage Period, highly significant. Odor -- all taster x treatment interactions were highly significant.

Combination #7 - Cabbage-carrot (64% - 36%)

The statistical evaluation of the organoleptic results for cabbage-carrot (#7) discs are given in Tables 76 and 77. The panel members concluded that there were highly significant flavor differences due to the effects of storage period and R.H. A highly significant interaction existed between these two effects (Table 78).

According to Table 78, the stored samples appeared to gain in acceptance with time, although this varied with R.H. Greater acceptance seemed to be for the samples stored at 0%, 3.0%, and 7.0% R.H. levels than for the three higher levels.

The effects of storage period and R.H. on odor were highly significant and significant, respectively. There was no interaction between these two treatments. The means of the hedonic rating for the various R.H. levels were as follows:

Relative Humidity (%)	Flavor*	Odor
0	5.2	5.2
3.0	5.5	5.3
7.0	5.1	5.3
11.1	4.9	5.0
20.4	5.2	5.3
31.9	4.8	5.2

* Interaction (R.H. x Storage Period)

Those samples stored at 11.1% R.H. were apparently rated poorer by the panel than the other samples (flavor discussed alone).

The analysis of variance of the organoleptic evaluations revealed a significant flavor difference due to compression not evident odor-wise.

There was a highly significant Storage Period x Compression interaction for odor and flavor (Tables 79, 80).

Storage appeared to enhance the samples except for the uncompressed material. The uncompressed material seemed to be scored more favorably than the compressed material, flavor-wise, with the exception of the samples evaluated at four months storage.

These results should be tempered with the fact that all of the taster x treatment interactions were highly significant.

Combination #8 - Strawberry-apple (50% - 50%)

The statistical analysis calculations for the organoleptic evaluation of the strawberry-apple discs are given in Tables 81 and 82. The tasters concluded that there were highly significant flavor and odor differences due to compression and relative humidities. A highly significant interaction existed between these two effects (Tables 83 and 84). The uncompressed material showed a general decline in acceptance as the percent relative humidity increased. The effect of compression varied with R.H. levels, but generally speaking, the uncompressed material appeared to be rated better than the compressed material.

The statistical analysis of the taste panel results detected a highly significant odor difference over the storage period not evident flavor-wise. The means of the hedonic ratings for the various storage periods were as follows:

Storage Period	Flavor*	Odor
0	6.6	6.5
1	6.6	6.4
2	6.5	6.3
3	6.4	6.3

* Not significant

The storage periods appeared to have a detrimental effect on the odor of the samples, although the difference between the means was not great.

These results should be tempered with the fact that the following taster interactions were found: Odor -- all Taster x treatment interactions, highly significant. Flavor -- Tasters x R.H., significant; Tasters x Compression, highly significant.

C. Rehydration results

The results of the rehydration tests for all eight combination foods are summarized on Tables 85 through 92. (Note: On some data sheets, the rehydration times are represented by dashes in the 2- and/or 3-months columns. This was a typographical omission -- the dashes represent identical rehydration times of the previous month.) Rehydration was measured as the time in minutes required for complete disintegration and/or apparent rehydration in water at 68° F.

With few exceptions, most combination foods rehydrated within a practical time of half an hour or less. The tabulated results on the data sheets are relative measurements, because it is difficult to quantify rehydration. The strawberry-apple combination exhibited rapid rehydration of the apples but slow rehydration of the strawberries. The cabbage-carrot combination fragmented rapidly but rehydrated unevenly. Powdery or granular combinations such as beef-eggs and beef-potatoes disintegrated rapidly in water with no measurement of particle rehydration possible.

For discussing rehydration, the combination foods can be placed into four groups, each group possessing slightly different rehydration characteristics. The groups are as follows:

Group I - Beef-potatoes and beef-eggs

Both combinations had rapid rehydration times of one minute or less. This rapid rehydration time was not affected by compression, storage R.H. or storage time.

Group II - Cabbage-carrot

These two combinations rehydrated alike, in that compression had a moderate effect on rehydration time. The rehydration times, however, were not affected by storage time or R.H.

Group III - Beef-spinach and spinach-egg

The rehydration times of both beef-spinach combinations was affected by R.H. and somewhat by compression. The beef-spinach combination with 75% beef revealed that both compression and R.H. had more significant effects on rehydration time. Compression affected the rehydration time of the spinach-egg combination significantly, but this significant difference was not affected by R.H. or time.

Group IV - Strawberry-apple

The strawberry-apple combination is in this group all by itself. The rehydration time of this combination was affected by compression, R.H. and, to some extent, storage. This combination also exhibited long rehydration times. As mentioned earlier, each component of this combination rehydrated at a different rate, and it was possible to have a rehydrated apple piece adjacent to an incompletely hydrated strawberry. The particle sizes of the strawberry complicated the rehydration test since compressed, powdered strawberries wetted more rapidly than compressed intact pieces of strawberries.

In the final analysis, the effects of compression on rehydration are obscured by the component rehydration characteristics and particle size. The effects of increasing R.H. and storage time appeared to have a minor effect on rehydratability.

IV. SUMMARY

This study pertained to the effects of compression and subsequent storage of combination foods on compatibility of components, moisture sorption characteristics, and storage stability. Eight discs were prepared. Results varied slightly with the individual discs, but generally:

A. Compression did not produce differences in equilibrium relative humidity moisture contents in comparison to uncompressed compositions, when moisture was measured by a direct oven solids method. Moisture relationships valid for uncompressed compositions should, therefore, hold for similar compressed samples. With some bars, moisture levels were determined by calculation from weight changes from a known initial moisture content; compression indicated an "apparent" equilibration to higher levels. Causes of this discrepancy are not evident.

B. Generally, storage stability, as measured by changes in chemical composition and in organoleptic acceptability, was not significantly affected by compression at the levels studied. There were isolated instances where compression did result in less loss of desirable chemical components. There were several instances, beef-spinach and beef-potato combinations, where compression resulted in greater organoleptic acceptability.

C. With the exception of the strawberry-apple disc, compression at the levels studied did not significantly hinder rehydration. In several instances, the rehydration characteristics of the entire disc were governed by the properties of one of the components.

D. Storage relative humidity and time were major factors in the chemical stability of both compressed and uncompressed discs. At the lower relative humidities, less losses of ascorbic acid, carotene and anthocyanin occurred, but enhanced lipid deterioration was measured by changes in malonaldehyde and free fatty acid was noted. While free fatty acid formation was lowest in the 7% - 11.1% R.H. range for beef-potatoes, there was no other indication of a narrow optimum R.H. range or monolayer value that was beneficial for maximum storage stability.

A statistical examination of the organoleptic acceptance scores for the discs tabulated according to R.H. levels was usually obscured by interactions with compression and storage time. However, the mean scores indicated that the most acceptable R.H. levels during storage were 7% and lower.

E. Lipid oxidation was evaluated by malonaldehyde measurement (TBA test). In one instance -- Spinach-eggs -- results were as anticipated. The malonaldehyde content increased with storage time and at a greater rate at the lower R.H. levels. However, with the other four lipid-containing combinations, frequent negative results were obtained, even at the lower R.H. levels. It is conceivable that combining the foods either nullified the applicability of the test or that there may have been a protective effect on lipid breakdown.

F. Component compatibility *per se* could not be strictly evaluated. The study of the chemical and organoleptic characteristics of individual compressed foods was beyond the scope of the study. However, it would appear that, since there was no indication of a specific R.H. level or monolayer value for best stability, all components were compatible if stored at R.H. levels of 7% and lower.

V. LITERATURE CITED

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TABLE 1

FOODS USED IN EXPERIMENTS

I - FREEZE-DRIED FOODS (MADE IN FMC PILOT DRYER)

Class	Item	Remarks
IV	Apples, Diced	Special pack of frozen diced apples purchased from Manteca Frozen Foods, Manteca, California
II	Beef, Ground Pre-cooked	Local purchase of ground beef Moisture expressed on fat-free basis (17.8% fat)
III	Carrots, diced	Produced from regular IQF frozen carrots - local purchase
II	Eggs, scrambled	Produced from Grade A whole eggs, produced according to QMC Limited Production Purchase Description - Eggs, pre-cooked, freeze-dried, LP/P DES C-203-63 1 February 1963 Moisture expressed on fat-free basis (22.0%)
III	Spinach, chopped	Packaged frozen spinach (blanched)
IV	Strawberries	Local purchase of fresh strawberries

II - AIR-DRIED FOODS (PURCHASED)

III	Cabbage, Raw	Purchased from California Vegetable Concentrates, Modesto, California
I	Potatoes, Instant white mashed	From R. T. French Co., Rochester, New York Moisture content raised to 16.67% for compression purposes

TABLE 2

INITIAL MOISTURE CONTENT* - INDIVIDUAL FOODS
Expressed as % of oven solids

Apples, diced -- 1.75
Beef, ground -- 0.45 (moisture on fat-free basis 17.8% fat)
Carrots, diced -- 3.79
Eggs, scrambled -- 0.28 (moisture on fat-free basis 22.0% fat)
Spinach, chopped -- 2.0
Strawberries -- 1.64
Cabbage -- 2.96
Potatoes, instant mashed -- 16.67 (Initial moisture content of 8% too low for compressing cohesive discs. Moisture content increased by incremental addition of water and equilibration until 16.67% moisture level)

* Moisture determined by vacuum oven analysis - 16 hours at 70° C.

FOOD COMBINATIONS

Combination number	Item A Food	Item A % used*	Item B Food	Item B % used*	Calculated* Final RH Range	Class Combinations
1	Beef	75	Spinach	25	0 - 2	II & III
2	Beef	50	Eggs	50	0 - 2	II & II
3	Beef	39	Spinach	61	2 - 5	II & III
4	Spinach	25	Eggs	75	2 - 5	I & III
5	Beef	55	Potatoes	45	open	I & II
6	Cabbage	82	Carrots	18	8 - 13	III & III
7	Cabbage	64	Carrots	36	13 - 16	III & III
8	Apples	50	Strawberries	50	5 - 8	IV & IV

* Calculation based on Salwin's formula

TABLE 3

COMPRESSION SPECIFICATIONS
FOR COMBINATION FOODS

Combination Number	Percent Mixture	Compression Levels psi/30 secs	Weight of mixed and compressed sample (grams)*
1	Beef (75) + Spinach (25)	P_1 - 300 P_2 - 750	20 24
2	Beef (50) + Eggs (50)	P_1 - 500 P_2 - 1000	20 22
3	Beef (39) + Spinach (61)	P_1 - 330 P_2 - 1100	12 18
4	Spinach (25) + Eggs (75)	P_1 - 500 P_2 - 1000	16 17
5**	Beef (55) + Potatoes (45)	P_1 - 3000 P_2 - 4000	25 30
6	Cabbage (82) + Carrots (18)	P_1 - 300 P_2 - 500	14 17
7	Cabbage (64) + Carrots (36)	P_1 - 300 P_2 - 500	12 13
8	Apples (50) + Strawberry (50)	P_1 - 200 P_2 - 300	10 12

* Weight required to produce 1/2 inch thick disc at specified pressure

** Potato moisture raised to 16.67%. Food and die must be at 50° F. for compression.

Table 4

Salts and Relative Humidity Levels Used for Moisture-Equilibrium Relative Humidity Isotherms

	Relative Humidity		
	72°F.	100°F.	
Magnesium percholorate	0	0	
Sulfuric acid solution 1 (Specific gravity 1.647*)	2.50	3.00	
Sodium hydroxide	7.0	7.0	
Lithium chloride	11.1	11.1	
Potassium acetate	23.0	20.4	
Magnesium chloride	32.9	31.9	
Potassium carbonate	43.7		
Sodium chloride	75.8		

*Measured with a Westphal balance at 25/25.

TABLE 5

CHEMICAL TESTS PERFORMED ON COMBINATION FOODS

Combination Number	Combination & Percentages	Ascorbic Acid	Carotene	Free Fatty Acid	Thio-barbituric Acid	Antho-cyanin Pigments	Reflectance	
							Pigment-free Residue	Whol Samp
1	Beef 75 Spinach 25	x	x		x		x	
2	Beef 50 Eggs 50		x		x		x	
3	Beef 39 Spinach 61	x	x		x		x	
4	Spinach 25 Eggs 75	x	x		x		x	
5	Beef 55 Potatoes 45			x	x			x
6	Cabbage 82 Carrots 18	x	x				x	
7	Cabbage 64 Carrots 36	x	x				x	
8	Strawberry 50 Apples 50	x				x	x	

TABLE 6

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

BEEF AND SPINACH #1
72° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months)				Moisture Content**	
		0	1	2	3	by direct method	by analysis
0	P_1	0.62	0.06	-0.06	-0.09	-0.09	1.04
	P_2	0.62	-0.58	-0.60	-0.63	-0.58	0.89
	Control	0.62	0.17	-0.17	-0.16	-0.16	1.98
2.5	P_1	0.62	1.06	1.14	1.16	1.16	2.05
	P_2	0.62	1.15	1.27	1.31	1.31	1.93
	Control	0.62	1.55	1.56	1.69	1.81	2.69
7.0	P_1	0.62	2.30	2.45	2.38	2.36	3.05
	P_2	0.62	2.36	2.47	2.48	2.47	3.02
	Control	0.62	2.40	2.38	2.31	2.31	3.14
11.1	P_1	0.62	3.02	3.07	3.06	3.06	3.66
	P_2	0.62	3.01	3.09	3.09	3.09	3.55
	Control	0.62	3.25	3.29	3.28	3.25	3.77
23.0	P_1	0.62	4.82	4.83	4.86	4.86	5.32
	P_2	0.62	4.86	4.89	4.85	4.85	5.36
	Control	0.62	4.66	4.58	4.55	4.55	5.30
32.9	P_1	0.62	6.21	6.10	6.28	6.28	6.75
	P_2	0.62	6.33	6.29	6.18	6.18	6.90
	Control	0.62	6.33	5.82	5.77	5.77	6.65
43.7	P_1	0.62	7.99	7.89	7.79	7.81	8.49
	P_2	0.62	7.92	7.83	7.74	7.74	8.34
	Control	0.62	7.62	7.49	7.96	7.92	8.73
75.8	P_1	0.62	16.85	17.28	17.04	17.04	mold
	P_2	0.62	15.92	17.14	16.80	16.80	mold
	Control	0.62	17.39	17.07	16.85	16.95	17.72

* P_1 - 1100 psi; P_2 - 2000 psi

** Percent oven solids

TABLE 7

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND FRH MOISTURE CONTENTS

BEEF AND SPINACH #1
100° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	3	Moisture Content** by direct method	by analysis
0	P_1	0.62	-0.16	-0.16	-0.16	-0.16	0.52
	P_2	0.62	-0.29	-0.16	-0.20	-0.20	0.46
	Control	0.62	-0.97	-0.98	-1.07	-1.12	0.28
3.0	P_1	0.62	1.23	1.27	1.29	1.29	2.17
	P_2	0.62	1.13	1.[illegible]	1.23	1.23	2.13
	Control	0.62	1.16	1.16	1.[illegible]7	1.17	2.01
7.0	P_1	0.62	1.53	1.56	1.56	1.56	2.30
	P_2	0.62	1.47	1.50	1.46	1.44	2.09
	Control	0.62	1.35	1.62	1.56	1.46	2.30
11.1	P_1	0.62	2.13	2.10	2.04	2.02	2.78
	P_2	0.62	2.36	2.30	2.27	2.23	2.87
	Control	0.62	2.04	1.89	1.81	1.76	2.65
2[illegible].4	P_1	0.62	3.52	3.30	3.28	3.28	4.17
	P_2	0.62	3.57	3.61	3.52	3.47	4.22
	Control	0.62	3.29	3.20	3.08	2.94	3.96
31.9	P_1	0.62	5.00	4.90	4.81	4.77	5.57
	P_2	0.62	5.00	4.89	4.78	4.68	5.55
	Control	0.62	4.70	4.55	4.38	4.26	5.58

*P_1 = 1100 psi; P_2 = 2000 psi

** Percent oven solids

TABLE 8

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

BEEF AND EGGS #2
72° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months)				Moisture Content**	
		0	1/2	1	3	by direct method	by analysis
0	P_1	0.78	0.58	0.46	0.60	0.48	0.69
	P_2	0.78	0.50	0.41	0.49	0.44	0.76
	Control	0.78	0.13	0.03	0.16	0.16	0.69
2.5	P_1	0.78	1.19	1.23	1.41	1.36	1.61
	P_2	0.78	1.00	1.03	1.14	1.14	1.71
	Control	0.78	0.99	1.06	1.03	1.04	1.60
7.0	P_1	0.78	2.44	2.50	2.54	2.54	2.68
	P_2	0.78	2.24	2.31	2.35	2.35	2.78
	Control	0.78	2.33	2.33	2.39	2.40	2.79
11.1	P_1	0.78	3.29	3.30	3.34	3.33	3.54
	P_2	0.78	3.14	3.23	3.26	3.23	3.44
	Control	0.78	3.10	3.11	3.19	3.18	3.65
23.0	P_1	0.78	5.13	5.16	5.15	5.15	5.44
	P_2	0.78	5.13	5.13	5.16	5.16	5.31
	Control	0.78	5.10	5.10	5.19	5.19	5.46
32.9	P_1	0.78	6.71	6.70	6.64	6.60	6.91
	P_2	0.78	6.71	6.73	6.68	6.64	7.03
	Control	0.78	6.66	6.61	6.59	6.59	7.08
43.7	P_1	0.78	8.36	8.33	8.25	8.21	8.73
	P_2	0.78	8.45	8.49	8.35	8.31	8.63
	Control	0.78	8.44	8.38	8.33	8.33	8.54
75.8	P_1	0.78	17.51	18.24	18.73	18.73	mold
	P_2	0.78	17.03	18.25	18.85	18.87	18.23
	Control	0.78	18.60	18.31	18.31	mold	mold

* P_1 - 500 psi; P_2 - 1000 psi

** Percent oven solids

TABLE 9

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

BEEF AND EGGS #2
100° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months) 0	1/2	1	3	Moisture Content ** by direct method	by analysis
0	P_1	0.78	0.20	0.20	0.23	0.23	0.59
	P_2	0.78	0.21	0.20	0.23	0.23	0.56
	Control	0.78	0.24	0.11	0.15	0.15	0.50
3.0	P_1	0.78	1.17	1.15	1.26	1.26	1.70
	P_2	0.78	1.13	1.14	1.19	1.19	1.70
	Control	0.78	0.96	0.89	0.89	0.89	1.51
7.0	P_1	0.78	2.05	1.93	1.91	1.91	2.23
	P_2	0.78	2.00	1.93	1.91	1.91	2.19
	Control	0.78	1.89	1.70	1.73	1.73	2.29
11.1	P_1	0.78	2.73	2.64	2.59	2.59	2.86
	P_2	0.78	2.70	2.65	2.60	2.60	2.95
	Control	0.78	2.59	2.40	2.33	2.33	3.09
20.4	P_1	0.78	4.23	4.14	4.14	4.14	4.31
	P_2	0.78	4.39	4.24	4.24	4.24	4.33
	Control	0.78	4.03	4.03	4.06	4.06	4.60
31.9	P_1	0.78	5.61	5.48	5.33	5.34	5.79
	P_2	0.78	5.83	5.66	5.54	5.66	5.83
	Control	0.78	5.43	5.39	5.26	5.43	6.29

*P_1 = 500 psi; P_2 = 1,000 psi

** Percent oven solids

TABLE 10

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

BEEF AND SPINACH #3
72° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	3	Moisture Content** by direct method	by analysis
0	P_1	0.72	-0.10	-0.26	-0.28	-0.29	0.73
	P_2	0.72	-0.24	-0.50	-0.56	-0.56	1.02
	Control	0.72	-0.74	-0.64	-0.64	-0.64	0.66
2.5	P_1	0.72	0.83	0.90	1.00	1.00	2.03
	P_2	0.72	0.43	0.46	0.49	0.49	2.12
	Control	0.72	0.57	0.65	0.72	0.71	2.30
7.0	P_1	0.72	1.73	1.74	1.73	1.73	2.58
	P_2	0.72	1.65	1.64	1.66	1.66	2.61
	Control	0.72	1.40	1.39	1.37	1.42	2.74
11.1	P_1	0.72	2.26	2.25	2.24	2.24	3.42
	P_2	0.72	2.74	2.74	2.72	2.72	3.46
	Control	0.72	1.98	1.98	1.92	1.94	3.35
23.0	P_1	0.72	4.02	3.98	3.92	3.92	4.92
	P_2	0.72	4.23	4.17	4.21	4.13	5.45
	Control	0.72	3.73	3.70	4.29	3.78	4.94
32.9	P_1	0.72	5.25	5.16	5.08	5.07	6.13
	P_2	0.72	5.24	5.18	5.09	5.08	6.08
	Control	0.72	4.83	4.78	4.71	4.71	5.92
43.7	P_1	0.72	6.81	6.69	6.59	6.56	7.59
	P_2	0.72	7.04	6.93	6.84	6.79	8.49
	Control	0.72	6.70	6.75	6.67	6.67	7.42
75.8	P_1	0.72	16.70	16.77	16.23	15.93	16.99
	P_2	0.72	17.18	17.22	16.75	16.41	17.22
	Control	0.72	17.45	17.45	17.16	16.94	17.25

*P_1 = 330 psi; P_2 = 1100 psi

** Percent oven solids

TABLE 11

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

BEEF AND SPINACH #3
100° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	3	Moisture Content** by direct method	by analysis
0	P_1	0.72	-0.75	-0.76	-0.78	-0.75	0.68
	P_2	0.72	-0.71	-0.70	-0.68	-0.68	0.77
	Control	0.72	-1.65	-1.69	-1.70	-1.70	0.33
3.0	P_1	0.72	0.79	0.58	0.56	0.57	2.19
	P_2	0.72	0.43	0.46	0.45	0.51	1.80
	Control	0.72	0.50	0.42	0.40	0.35	1.37
7.0	P_1	0.72	0.82	0.79	0.76	0.75	2.18
	P_2	0.72	0.95	0.92	0.93	0.93	2.19
	Control	0.72	0.30	0.25	0.18	0.16	1.98
11.1	P_1	0.72	1.74	1.67	1.62	1.62	2.97
	P_2	0.72	1.92	1.85	1.80	1.75	3.08
	Control	0.72	0.77	0.86	0.83	0.72	2.85
20.4	P_1	0.72	2.95	2.95	2.99	2.99	4.62
	P_2	0.72	3.03	2.94	2.86	2.86	4.47
	Control	0.72	1.48	1.39	1.24	1.08	3.89
31.9	P_1	0.72	4.18	4.07	3.88	3.80	5.74
	P_2	0.72	4.39	4.23	4.08	4.00	5.78
	Control	0.72	2.32	2.20	1.97	1.78	5.19

*P_1 = 330 psi; P_2 = 1100 psi

** Percent oven solids

TABLE 12

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

SPINACH AND EGGS #4
72° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	3	Moisture Content** by direct method	by analysis
0	P_1	0.85	0.12	0.16	0.14	0.10	1.03
	P_2	0.85	0.07	-0.02	0.05	0.05	0.79
	Control	0.85	-0.28	-0.12	-0.14	-0.14	0.98
2.5	P_1	0.85	0.92	0.90	0.92	0.92	1.93
	P_2	0.85	0.83	0.94	1.08	1.01	1.76
	Control	0.85	0.34	0.35	0.34	0.35	1.79
7.0	P_1	0.85	1.99	2.10	2.17	2.17	3.07
	P_2	0.85	1.87	2.00	1.94	1.99	2.89
	Control	0.85	1.39	1.40	1.37	1.43	2.84
11.1	P_1	0.85	2.59	2.58	2.53	2.57	3.31
	P_2	0.85	2.62	2.58	2.59	2.56	3.55
	Control	0.85	2.45	2.45	2.45	2.47	3.53
23.0	P_1	0.85	4.33	4.30	4.26	4.31	5.04
	P_2	0.85	4.46	4.43	4.38	4.43	5.17
	Control	0.85	4.75	4.38	4.32	4.43	5.22
32.9	P_1	0.85	5.72	5.64	5.57	5.62	6.52
	P_2	0.85	5.84	5.78	5.68	5.70	6.55
	Control	0.85	5.34	5.32	5.18	5.26	6.37
43.7	P_1	0.85	7.38	7.27	7.18	7.21	8.21
	P_2	0.85	7.70	7.55	7.44	7.46	8.32
	Control	0.85	7.03	6.95	6.80	6.85	7.86
75.8	P_1	0.85	18.37	19.02	19.08	19.08	19.72
	P_2	0.85	18.65	19.44	19.45	19.45	20.11
	Control	0.85	18.36	18.70	18.47	18.76	mold

* P_1 = 500 psi; P_2 = 1000 psi

** Percent of oven solids

TABLE 13

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

SPINACH AND EGGS #4
100 °F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	3	Moisture Content** by direct method	by analysis
0	P_1	0.85	-0.43	-0.41	-0.46	-0.46	0.48
	P_2	0.85	-13.90	-13.92	-13.97	-13.97	0.68
	Control	0.85	-1.14	-1.79	-1.94	-1.94	0.48
3.0	P_1	0.85	0.55	0.59	0.66	0.66	1.40
	P_2	0.85	0.71	0.78	0.86	0.86	1.55
	Control	0.85	0.65	0.65	0.68	0.68	1.66
7.0	P_1	0.85	1.14	1.12	1.12	1.12	2.20
	P_2	0.85	1.36	1.33	1.34	1.34	2.10
	Control	0.85	1.19	0.95	0.95	0.95	2.08
11.1	P_1	0.85	2.08	2.04	2.05	2.05	2.87
	P_2	0.85	2.00	1.97	1.97	1.97	2.70
	Control	0.85	1.43	1.22	1.28	1.33	2.68
20.4	P_1	0.85	3.35	3.35	3.34	3.34	4.06
	P_2	0.85	3.16	3.13	3.16	3.16	4.00
	Control	0.85	2.68	2.41	2.60	2.60	4.08
31.9	P_1	0.85	4.74	4.64	5.03	4.79	5.26
	P_2	0.85	4.55	4.43	4.43	4.43	5.34
	Control	0.85	4.12	3.85	3.70	3.70	5.70

* P_1 = 500 psi; P_2 = 1000 psi

** Percent oven solids

TABLE 14

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

MEAT AND POTATOES #5
72° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months)				Moisture Content**	
		0	1	2	3	by direct method	by analysis
0	P_1	8.69	4.06	3.76	3.65	3.65	2.11
	P_2	8.69	3.89	3.09	2.87	2.87	0.90
	Control	8.69	2.82	2.56	2.63	2.63	0.61
2.5	P_1	8.69	5.19	5.14	5.12	5.12	3.45
	P_2	8.69	5.26	5.04	5.08	5.08	3.59
	Control	8.69	4.54	4.62	4.74	4.74	3.78
7.0	P_1	8.69	5.85	5.63	5.47	5.47	3.97
	P_2	8.69	5.93	5.71	5.61	5.61	4.07
	Control	8.69	5.94	6.64	6.71	6.71	3.87
11.1	P_1	8.69	6.62	6.48	6.11	6.11	4.69
	P_2	8.69	6.69	6.52	6.42	6.42	4.29
	Control	8.69	6.81	6.74	6.64	6.64	4.46
23.0	P_1	8.69	8.74	8.32	8.09	8.09	6.41
	P_2	8.69	8.35	8.25	8.15	8.15	6.07
	Control	8.69	8.72	8.69	8.44	8.69	6.28
32.9	P_1	8.69	9.54	9.53	9.24	9.24	7.57
	P_2	8.69	9.46	9.42	9.25	9.25	7.61
	Control	8.69	9.78	9.69	9.54	9.54	7.68
43.7	P_1	8.69	10.53	10.46	10.27	10.27	8.97
	P_2	8.69	11.14	11.00	10.85	10.85	8.99
	Control	8.69	11.26	11.13	10.97	10.97	--
75.0	P_1	8.69	18.94	19.01	18.56	18.56	16.74
	P_2	8.69	18.18	18.60	18.59	18.59	16.37
	Control	8.69	19.04	18.84	18.49	18.63	mold

* P_1 = 2000 psi; P_2 = 4000 psi

** Percent of oven solids

TABLE 15

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

MEAT AND POTATOES #5
100° F.
Fat Free Basis

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	3	Moisture Content** by direct method	by analysis
0	P_1	8.69	2.48	2.34	2.29	2.29	1.02
	P_2	8.69	2.37	2.02	1.97	1.97	0.726
	Control	8.69	2.71	2.63	2.63	2.63	0.72
3.0	P_1	8.69	4.52	4.49	4.48	4.48	3.28
	P_2	8.69	4.43	4.40	4.42	4.42	2.90
	Control	8.69	3.84	3.67	3.63	3.63	2.42
7.0	P_1	8.69	5.86	5.10	4.76	4.66	3.20
	P_2	8.69	4.76	5.35	4.58	4.52	3.47
	Control	8.69	4.83	5.23	5.20	5.20	3.75
11.1	P_1	8.69	5.74	5.58	5.54	5.54	4.13
	P_2	8.69	5.70	5.47	5.48	5.48	4.07
	Control	8.69	5.43	5.08	4.90	4.72	4.09
20.4	P_1	8.69	7.00	6.83	6.00	6.80	5.11
	P_2	8.69	6.93	6.74	6.66	6.66	5.20
	Control	8.69	7.13	6.94	6.88	6.85	4.85
31.9	P_1	8.69	8.17	7.94	7.82	7.82	6.51
	P_2	8.69	8.01	7.80	7.76	7.76	6.57
	Control	8.69	8.22	8.05	7.99	7.99	6.53

* P_1 = 2000 psi; P_2 = 4000 psi

** Percent of oven solids

TABLE 16

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

CABBAGE AND CARROTS #6
72° F.

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	4	Moisture Content** by direct method	by analysis
0	P_1	3.11	1.67	1.39	--	--	1.50
	P_2	3.11	1.49	1.11	0.64	0.57	1.96
	Control	3.11	1.68	1.30	0.80	0.73	
2.5	P_1	3.11	1.74	1.37	0.99	0.90	1.29
	P_2	3.11	1.66	1.28	0.89	0.83	1.60
	Control	3.11	1.94	1.60	1.23	1.17	
7.0	P_1	3.11	1.94	1.50	1.20	1.11	1.74
	P_2	3.11	2.00	1.64	1.23	1.14	1.92
	Control	3.11	2.25	1.96	1.59	1.52	
11.1	P_1	3.11	2.22	1.90	1.65	1.53	2.00
	P_2	3.11	2.21	1.92	1.59	1.50	1.30
	Control	3.11	2.43	2.17	1.86	1.86	
23.0	P_1	3.11	3.23	3.16	3.02	3.02	3.41
	P_2	3.11	3.11	3.10	2.99	2.99	3.69
	Control	3.11	3.25	3.22	3.12	3.12	
32.9	P_1	3.11	4.86	4.96	4.94	4.94	5.74
	P_2	3.11	4.99	5.17	5.12	5.12	
	Control	3.11	4.93	5.16	5.18	5.18	
43.7	P_1	3.11	8.21	8.23	8.05	8.01	
	P_2	3.11	8.41	8.89	8.76	8.76	9.07
	Control	3.11	8.31	8.23	7.96	7.96	
75.8	P_1	3.11	25.85	27.63	mold	mold	mold
	P_2	3.11	23.56	27.56	27.33	27.17	
	Control	3.11	28.45	28.14	27.27	27.14	

* P_1 = 300; P_2 = 500 psi

** Percent oven solids

TABLE 17

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

CABBAGE AND CARROTS #6
100° F.

R.H.	Pressure Treatment*	Storage (Months)				Moisture Content**	
		0	1	2	4	by direct method	by analysis
0	P_1	3.11	0.12	-0.32	-0.64	-0.68	0.29
	P_2	3.11	0.18	-0.37	-0.63	-0.74	0.25
	Control	3.11	0.15	-0.26	-0.79	-0.82	0.28
3.0	P_1	3.11	0.34	0.05	-0.20	-0.20	0.58
	P_2	3.11	0.45	0.05	-0.14	-0.19	0.53
	Control	3.11	0.55	0.13	-0.17	-0.17	0.73
7.0	P_1	3.11	0.70	0.37	0.14	0.10	0.77
	P_2	3.11	0.77	0.45	0.17	0.12	0.78
	Control	3.11	1.30	0.95	0.55	0.48	0.81
11.1	P_1	3.11	1.04	0.88	0.64	0.64	1.14
	P_2	3.11	1.19	0.88	0.60	0.60	1.12
	Control	3.11	1.23	0.92	0.81	0.81	1.25
20.4	P_1	3.11	2.00	1.73	1.31	1.31	2.46
	P_2	3.11	2.35	2.12	1.84	1.84	2.41
	Control	3.11	2.28	1.95	1.67	1.59	2.30
31.9	P_1	3.11	4.17	3.97	3.70	3.57	4.63
	P_2	3.11	4.56	4.21	3.64	3.53	4.78
	Control	3.11	4.21	3.96	3.64	3.40	4.79

* P_1 = 300 psi; P_2 = 500 psi

** Percent oven solids

TABLE 18

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

CABBAGE AND CARROTS #7
72° F.

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	3	Moisture Content** by direct method	by analysis
0	P_1	3.26	1.56	1.16			
	P_2	3.26	1.58	1.29	0.85	0.78	
	Control	3.26	1.46	1.15	0.73	0.67	
2.5	P_1	3.26	1.77	1.56	1.28	1.28	
	P_2	3.26	1.96	1.69	1.50	1.50	
	Control	3.26	1.89	1.60	1.11	1.17	1.49
7.0	P_1	3.26	2.11	1.84	1.59	1.59	
	P_2	3.26	2.36	2.04	1.86	1.86	
	Control	3.26	2.24	2.02	1.72	1.68	1.87
11.1	P_1	3.26	2.40	2.17	1.92	1.88	
	P_2	3.26	2.59	2.30	2.14	2.14	
	Control	3.26	2.54	2.35	2.10	2.04	2.14
23.0	P_1	3.26	3.48	3.35	3.27	3.23	
	P_2	3.26	3.73	3.65	3.55	3.55	
	Control	3.26	3.45	3.35	3.25	3.25	3.00
32.9	P_1	3.26	5.22	5.28	5.27	5.27	
	P_2	3.26	5.57	5.64	5.54	5.54	
	Control	3.26	5.14	5.25	5.22	5.22	4.54
43.7	P_1	3.26	8.40	8.35	8.22	8.14	
	P_2	3.26	8.71	8.71	8.49	8.49	
	Control	3.26	8.42	8.37	8.13	8.12	
75.8	P_1	3.26	26.48	26.62	mold		
	P_2	3.26	26.07	27.35	27.29	27.29	
	Control	3.26	27.60	27.70	mold		

* P_1 = 300 psi; P_2 = 500 psi

** Percent oven solids

TABLE 19

RATE OF A[illegible]TAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

CABBAGE AND CARROTS #7
100° F.

R.H.	Pressure Treatment*	Storage (Months) 0	1	2	4	Moisture Content** by direct method	by analysis
0	P_1	3.26	0.14	-0.24	-0.58	-0.58	0.19
	P_2	3.26	0.47	0.18	-0.15	-0.15	0.17
	Control	3.26	0.25	-0.02	-0.81	-0.81	0.21
3.0	P_1	3.26	0.43	0.17	-0.03	-0.04	0.68
	P_2	3.26	0.80	0.56	0.36	-0.36	0.74
	Control	3.26	0.58	0.18	-0.23	-0.23	0.52
7.0	P_1	3.26	0.97	0.70	0.41	0.37	0.93
	P_2	3.26	1.18	0.95	0.71	0.71	0.89
	Control	3.26	0.97	0.68	0.47	0.43	0.81
11.1	P_1	3.26	1.18	1.01	0.8[illegible]	0.83	1.40
	P_2	3.26	1.56	1.35	1.[illegible]	1.13	1.30
	Control	3.26	1.14	0.81	--	--	1.44
20.4	P_1	3.26	2.31	2.18	1.94	1.94	2.41
	P_2	3.26	2.75	2.61	2.38	2.32	2.58
	Control	3.26	2.51	2.39	2.26	2.26	2.59
31.9	P_1	3.26	4.42	4.19	3.63	3.55	4.58
	P_2	3.26	4.86	4.63	4.26	4.05	4.54
	Control	3.26	4.50	--	--	--	4.63

*P_1 = 300 psi; P_2 = 500 psi

** Percent oven solids

TABLE 20

Apple-Strawberry #8
72° F.

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS AND ERH MOISTURE CONTENTS

Relative Humidity	Pressure (psi) Dwell (sec.)	Storage Time (Months) 0	1	2	3	Equilibrium R.H.*
0	200/30	3.11	0.73	0.68	0.60	0.60
	300/30	3.11	0.74	0.67	0.59	0.59
	Control	3.11	0.44	0.33	0.32	0.32
3.0	200/30	3.11	1.12	1.25	1.28	1.28
	300/30	3.11	1.13	0.98	0.97	0.97
	Control	3.11	0.74	0.74	0.74	0.74
7.0	200/30	3.11	1.75	1.76	1.74	1.74
	300/30	3.11	1.73	1.75	1.71	1.71
	Control	3.11	1.62	1.63	1.64	1.64
11.1	200/30	3.11	2.51	2.57	2.47	2.47
	300/30	3.11	2.42	2.47	2.45	2.45
	Control	3.11	2.21	2.32	2.20	2.20
23.0	200/30	3.11	5.02	5.01	4.86	4.86
	300/30	3.11	5.05	4.94	4.87	4.87
	Control	3.11	4.81	4.81	4.60	4.60
32.9	200/30	3.11	7.57	7.56	7.45	7.45
	300/30	3.11	7.61	7.56	7.49	7.49
	Control	3.11	7.31	7.32	7.18	7.18
43.7	200/30	3.11	10.90	10.94	10.70	10.70
	300/30	3.11	10.99	10.98	10.85	10.85
	Control	3.11	10.68	10.63	10.51	10.51
75.8	200/30	3.11	33.19	34.28	34.80	-
	300/30	3.11	32.76	35.71	36.31	-
	Control	3.11	34.70	35.01	34.54	34.54

* Percent oven solids

TABLE 21

Apple-Strawberry #8
100° F.

RATE OF ATTAINMENT AFTER 3 STORAGE PERIODS
AND ERH MOISTURE CONTENTS

Relative Humidity	Pressure (psi) Dwell (sec.)	Storage Time (Months)				Equilibrium R.H.*
		0	1	2	3	
0	200/30	1.67	0.25	0.12	0.07	0.07
	300/30	1.67	0.24	0.13	0.15	0.15
	Control	1.67	-0.15	-0.28	-0.33	-0.33
3.0	200/30	1.67	0.83	0.74	0.68	0.68
	300/30	1.67	0.80	0.72	0.69	0.69
	Control	1.67	0.28	0.00	0.02	0.02
7.0	200/30	1.67	1.26	1.09	0.95	0.95
	300/30	1.67	1.23	1.05	0.91	0.91
	Control	1.67	0.86	0.59	0.40	0.40
11.1	200/30	1.67	2.02	1.81	1.61	1.61
	300/30	1.67	2.02	1.82	1.66	1.66
	Control	1.67	1.83	1.21	0.93	0.93
20.4	200/30	1.67	3.60	3.32	3.11	3.11
	300/30	1.67	3.60	3.30	3.07	3.07
	Control	1.67	3.23	2.87	2.77	2.77
31.9	200/30	1.67	6.24	5.80	5.45	5.45
	300/30	1.67	6.25	5.88	5.59	5.59
	Control	1.67	5.97	5.56	5.19	5.19

* Percent oven solids

TABLE 22

BEEF COMBINATIONS - 72° F.
ERH Moisture Contents expressed as % oven solids

Relative Humidity	Pressure Treatment	By vacuum oven analysis				By direct weighing			
		#1 Beef 75% Spinach 25%	#3 Beef 39% Spinach 61%	#2 Beef 50% Eggs 50%	#5 Beef 55% Potato 45%	Phase I data - uncompressed single foods			
						Beef	Spinach	Eggs	Potato
0	P_1	1.04	0.73	0.69	2.11				
	P_2	0.89	1.02	0.76	0.90				
	Control	1.98	0.66	0.69	0.61	-0.43		1.40	3.81
2.5	P_1	2.05	2.03	1.61	3.45				
	P_2	1.93	2.12	1.71	3.59				
	Control	2.69	2.30	1.60	3.78	1.21	0.68	2.86	2.89
7.0	P_1	3.05	2.58	2.68	3.97				
	P_2	3.02	2.61	2.78	4.07				
	Control	3.14	2.74	2.79	3.87	2.51	1.68	3.56	4.37
11.1	P_1	3.66	3.42	3.54	4.69				
	P_2	3.55	3.46	3.44	4.29				
	Control	3.77	3.35	3.65	4.46	3.18	2.33	4.44	
23.0	P_1	5.32	4.92	5.44	6.41				
	P_2	5.36	5.45	5.31	6.07				
	Control	5.30	4.94	5.46	6.28	5.58	3.95	6.90	7.37
32.9	P_1	6.75	6.13	6.91	7.57				
	P_2	6.90	6.08	7.03	7.61				
	Control	6.65	5.92	7.08	7.68	6.86		8.85	8.70
43.7	P_1	8.49	7.59	8.73	8.97				
	P_2	8.34	8.49	8.63	8.99				
	Control	8.73	7.42	8.54		8.55		11.25	10.07
75.8	P_1	mold	16.99	mold	16.74				
	P_2	mold	17.22	18.23	16.37				
	Control	17.72	17.25	mold	mold	20.66	18.46	27.48	16.73
	P_1	1100 psi	330 psi	500 psi	2000 psi				
	P_2	2000 psi	1100 psi	1000 psi	4000 psi				

TABLE 23

BEEF COMBINATIONS - 100° F.
ERH Moisture Contents expressed as % oven solids

Relative Humidity	Pressure Treatment	By vacuum oven analysis #1 Beef 75% Spinach 25%	#3 Beef 39% Spinach 61%	#2 Beef 50% Eggs 50%	#5 Beef 55% Potato 45%	By direct weighing Phase I data - uncompressed single foods: Beef	Spinach	Eggs	Potato
0	P_1	0.52	0.68	0.59	1.02				
	P_2	0.46	0.77	0.56	0.72				
	Control	0.28	0.33	0.50	0.72	0.08	-1.01	0.41	-0.65
3.0	P_1	2.17	2.19	1.70	3.28				
	P_2	2.13	1.80	1.70	2.90				
	Control	2.01	1.87	1.51	2.42	0.59	0.37	1.30	2.03
7.0	P_1	2.30	2.18	2.23	3.20				
	P_2	2.09	2.19	2.19	3.47				
	Control	2.30	1.98	2.29	3.75	0.97	1.44	2.20	
11.1	P_1	2.78	2.97	2.86	4.13				
	P_2	2.87	3.08	2.95	4.07				
	Control	2.65	2.85	3.09	4.09	2.67	2.13	3.26	3.75
20.4	P_1	4.17	4.62	4.31	5.11				
	P_2	4.22	4.47	4.33	5.20				
	Control	3.96	3.89	4.60	4.85	3.54	3.02	4.87	5.26
31.9	P_1	5.57	5.74	5.79	6.51				
	P_2	5.55	5.78	5.83	6.57				
	Control	5.58	5.19	6.29	6.53	4.48		6.89	6.53
	P_1	1100 psi	330 psi	500 psi	2000 psi				
	P_2	2000 psi	1100 psi	1000 psi	4000 psi				

TABLE 24

SPINACH COMBINATIONS - 72° F.
ERH Moisture Contents expressed as % oven solids

Relative Humidity	Pressure Treatment	By vacuum oven analysis: #1 Spinach 25% Beef 75%	#3 Spinach 61% Beef 39%	#4 Spinach 25% Eggs 75%	By direct weighing: Phase I data - uncompressed single foods: Beef	Spinach	Eggs
0	P_1	1.04	0.73	1.03			
	P_2	0.89	1.02	0.79			
	Control	1.98	0.66	0.98	0.43	1.40	
2.5	P_1	2.05	2.03	1.93			
	P_2	1.[illegible]3	2.12	1.76			
	Control	2.69	2.30	1.79	1.21	[illegible].68	2.86
7.0	P_1	3.05	2.58	3.07			
	P_2	3.02	2.61	2.89			
	Control	3.14	2.74	2.84	2.51	1.68	3.56
11.1	P_1	3.66	3.42	3.31			
	P_2	3.55	3.46	3.55			
	Control	3.77	3.35	3.53	3.18	2.33	4.44
23.0	P_1	5.32	4.92	5.04			
	P_2	5.36	5.45	5.17			
	Control	5.30	4.94	5.22	5.58	3.95	6.90
32.9	P_1	6.75	6.13	6.52			
	P_2	6.90	6.08	6.55			
	Control	6.65	5.92	6.37	6.86		8.85
43.7	P_1	8.49	7.59	8.21			
	P_2	8.34	8.49	8.32			
	Control	8.73	7.42	7.86	8.55		11.25
75.8	P_1	mold	16.99	19.72			
	P_2	mold	17.22	20.11			
	Control	17.72	17.25	mold	20.66	18.46	27.48
	P_1	1100 psi	330 psi				
	P_2	2000 psi	1100 psi				

TABLE 25

SPINACH COMBINATIONS - 100° F.
ERH Moisture Contents expressed as % oven solids

Relative Humidity	Pressure Treatment	By vacuum oven analysis #1 Spinach 25% Beef 75%	#3 Spinach 61% Beef 39%	#4 Spinach 25% Eggs 75%	By direct weighing Phase I data - uncompressed single foods Beef	Spinach	Eggs
0	P_1	0.52	0.68	0.48			
	P_2	0.46	0.77	0.68			
	Control	0.28	0.33	0.48	0.08	-1.01	0.41
3.0	P_1	2.17	2.19	1.40			
	P_2	2.13	1.80	1.56			
	Control	2.01	1.87	1.66	0.59	0.37	1.30
7.0	P_1	2.30	2.18	2.20			
	P_2	2.09	2.19	2.10			
	Control	2.30	1.98	2.08	0.97	1.44	2.20
11.1	P_1	2.78	2.97	2.87			
	P_2	2.87	3.08	2.70			
	Control	2.65	2.85	2.68	2.67	2.13	3.26
20.4	P_1	4.17	4.62	4.06			
	P_2	4.22	4.47	4.00			
	Control	3.96	3.89	4.08	3.54	3.02	4.87
31.9	P_1	5.57	5.74	5.26			
	P_2	5.55	5.78	5.34			
	Control	5.58	5.19	5.70	4.48		6.89
	P_1	1100 psi	330 psi	500 psi			
	P_2	2000 psi	1100 psi	1000 psi			

TABLE 26

EGG COMBINATIONS - 72° F.
ERH Moisture Contents expressed as % oven solids

Relative Humidity	Pressure Treatment	#4 Eggs 75% Spinach 25%	#2 Eggs 50% Beef 50%	Phase I single foods ERH moisture contents by direct weighing method		
				Eggs	Spinach	Beef
0	P_1	1.03	0.69			
	P_2	0.79	0.76			
	Control	0.98	0.69	1.40		0.43
2.5	P_1	1.93	1.61			
	P_2	1.76	1.71			
	Control	1.79	1.60	2.86	0.68	1.21
7.0	P_1	3.07	2.68			
	P_2	2.89	2.78			
	Control	2.84	2.79	3.56	1.68	2.51
11.1	P_1	3.31	3.54			
	P_2	3.55	3.44			
	Control	3.53	3.65	4.44	2.33	3.18
23.0	P_1	5.04	5.44			
	P_2	5.17	5.31			
	Control	5.22	5.46	6.90	3.95	5.58
32.9	P_1	6.52	6.91			
	P_2	6.55	7.03			
	Control	6.37	7.08	8.85		6.86
43.7	P_1	8.21	8.73			
	P_2	8.32	8.63			
	Control	7.86	8.54	11.25		8.55
75.8	P_1	19.72	mold			
	P_2	20.11	18.23			
	Control	mold	mold	27.48	18.46	20.86
	P_1	500 psi	500 psi			
	P_2	1000 psi	1000 psi			

TABLE 27

EGG COMBINATIONS - 100° F.
ERH Moisture Contents expressed as % oven solids

Relative Humidity	Pressure Treatment	#4 Eggs 75% Spinach 25%	#2 Eggs 50% Beef 50%	Phase I single foods ERH moisture contents by direct weighing method		
				Eggs	Spinach	Beef
0	P_1 P_2 Control	0.48 0.68 0.48	0.59 0.56 0.50	0.41	-1.01	0.08
3.0	P_1 P_2 Control	1.40 1.56 1.66	1.70 1.70 1.51	1.30	0.37	0.59
7.0	P_1 P_2 Control	2.20 2.10 2.08	2.23 2.19 2.29	2.20	1.44	0.97
11.1	P_1 P_2 Control	2.87 2.70 2.68	2.86 2.95 3.09	3.26	2.13	2.67
20.4	P_1 P_2 Control	4.06 4.00 4.08	4.31 4.33 4.60	4.87	3.02	3.54
31.9	P_1 P_2 Control	5.26 5.34 5.70	5.79 5.83 6.29	6.89		4.48
	P_1 P_2	500 psi 1000 psi	500 psi 1000 psi			

TABLE 28

COMBINATION #1 - SPINACH AND BEEF
25% - 75%

PERCENT LOSS OF CAROTENE

Percent Relative Humidity	Storage Periods								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	21.7	21.0	20.2	29.6	27.7	27.0	30.4	33.1	32.0
3	22.0	20.8	20.9	29.4	28.8	27.5	29.0	33.2	32.8
7	22.3	23.0	22.8	32.3	30.4	30.2	33.8	34.2	34.1
11.1	24.0	24.0	23.9	31.8	31.3	30.7	33.9	36.4	34.9
20.4	24.3	23.5	23.0	32.2	30.6	30.1	35.5	35.5	35.3
31.9	25.6	26.3	25.9	32.0	32.2	31.8	36.5	36.9	37.2

PERCENT LOSS OF ASCORBIC ACID

Percent Relative Humidity	Storage Periods								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	50.7	50.8	50.8	60.8	58.3	58.3	66.8	68.0	66.7
3	53.4	53.0	53.0	66.6	66.1	67.0	74.0	74.5	74.6
7	55.1	56.1	56.2	67.6	67.9	67.9	77.4	75.5	75.7
11.1	57.4	56.0	58.2	75.5	74.6	74.6	80.8	78.7	78.8
20.4	59.1	57.4	57.4	86.5	85.3	82.9	89.8	88.6	88.7
31.9	62.6	60.5	60.5	88.7	88.9	89.8	90.8	91.0	89.9

P_1 = 300 psi/30 sec
P_2 = 750 psi/30 sec

TABLE 29

COMBINATION #1 - SPINACH AND BEEF
25% - 75%

PERCENT LOSS OF MALONALDEHYDE

Percent Relative Humidity	Storage Periods								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	18.9	18.7	17.4	20.1	19.7	21.9	19.3	23.6	24.2
3	18.61	18.9	18.2	21.1	20.6	22.9	18.0	21.1	25.3
7	17.2	14.8	16.7	21.8	22.5	23.2	33.5	24.5	29.2
11.1	18.8	19.1	17.6	24.9	23.6	29.1	33.9	35.8	37.1
20.4	22.3	21.5	25.0	29.8	28.3	27.0	43.2	42.7	44.2
31.9	22.7	24.9	23.9	34.2	39.3	36.2	43.5	42.9	43.1

P_1 = 300 psi/30 sec
P_2 = 750 psi/30 sec

TABLE 30

COMBINATION #1 - BEEF AND SPINACH
75% - 25%

PERCENT GAIN OF REFLECTANCE

Percent Relative Humidity	mu	Storage Periods: 1 Month P_0	P_1	P_2	2 Months P_0	P_1	P_2	3 Months P_0	P_1	P_2
0	500	-16.9	13.8	6.4	-11.9	9.8	-10.6	*	9.8	14.6
	530	-15.9	13.3	8.1	-10.9	9.8	-10.4	*	9.3	15.5
	655	-16.3	17.9	10.1	-2.3	17.1	0	*	23.8	32.1
3	500	-9.0	2.8	10.8	-11.9	15.2	-6.1	*	23.4	27.7
	530	-7.0	2.7	11.9	-11.6	14.3	-2.9	*	21.5	26.6
	655	-7.4	2.8	10.1	-10.0	18.6	-17.6	*	27.3	45.8
7	500	-2.9	6.9	6.4	-2.0	8.5	3.0	*	13.5	11.5
	530	4.6	6.6	6.2	-3.4	-5.5	-8.9	*	14.5	12.2
	655	7.0	4.2	5.5	8.2	-15.9	-11.8	*	15.3	12.5
11.1	500	-12.0	8.9	9.2	-15.6	-2.4	3.0	*	6.2	12.3
	530	-11.6	10.2	11.6	-15.9	-.91	3.9	*	5.9	14.1
	655	-7.8	4.2	10.1	-15.0	-6.4	-3.8	*	3.1	18.8
20.4	500	-6.9	15.8	2.4	-16.9	-9.8	19.7	*	6.2	38.5
	530	-5.2	17.2	3.5	-17.2	11.3	20.9	*	7.6	7.4
	655	-.78	22.6	5.5	-13.6	17.1	17.6	*	3.1	7.5
31.9	500	-5.5	-6.5	6.4	-16.9	14.3	5.8	*	14.2	20.0
	530	-1.8	-2.3	6.2	-17.2	14.3	4.5	*	14.5	19.3
	655	10.9	2.8	5.5	-15.9	17.1	5.9	*	19.2	25.0

* Values not available

TABLE 31

COMBINATION #2 - BEEF AND EGGS
50% - 50%

PERCENT LOSS OF CAROTENE

Percent Relative Humidity	Storage Periods								
	1/2 Month			1 Month			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	13.7	13.4	13.5	19.6	17.3	17.34	23.5	25.6	25.3
3	12.5	14.4	14.3	20.4	16.8	16.8	28.5	28.9	26.9
7	15.8	15.2	16.5	20.8	19.8	20.3	31.3	31.7	28.6
11.1	18.4	16.7	16.6	24.5	21.6	23.6	35.3	35.5	32.8
20.4	21.2	20.9	19.4	27.1	26.1	26.4	39.1	38.4	34.8
31.9	23.7	23.4	20.4	27.9	27.5	27.5	38.7	38.5	35.9

PERCENT GAIN OR LOSS OF MALONALDEHYDE

Percent Relative Humidity	Storage Periods								
	1/2 Month			1 Month			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	12.9	9.94	12.4	37.4	34.8	32.9	71.0	59.2	65.2
3	15.4	9.9	10.9	23.1	23.9	19.4	62.7	62.7	51.1
7	8.6	7.9	6.1	34.5	31.2	28.7	43.4	41.6	37.0
11.1	3.3	4.9	4.2	21.8	16.3	18.7	53.3	52.7	51.0
20.4	-1.4	5.5	4.36	5.17	18.2	-3.1	35.1	25.8	32.5
31.9	-1.8	- .49	.55	- .44	.05	-8.7	12.8	25.1	18.8

All changes indicate gain except those marked by minus (-) sign.

P_1 = 500 psi/30 sec.

P_2 = 1000 psi/30 sec.

TABLE 32

COMBINATION #2 - BEEF AND EGGS
50% - 50%

PERCENT LOSS OF REFLECTANCE

Percent Relative Humidity	mμ	Storage Periods								
		1/2 Month			1 Months			3 Months		
		P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	480	7.2	0	12.4	+4.8	13.6	4.2	.92	2.7	6.2
	540	2.7	+1.5	12.7	+5.7	17.2	7.8	+3.8	+1.9	1.4
3	480	3.4	0	7.9	2.2	3.2	4.2	1.5	3.4	6.2
	540	.81	+3.5	5.5	1.4	7.8	7.8	+3.9	+3.3	.28
7	480	+4.9	0	+.59	[illegible]	10.9	6.8	+9.2	+4.6	+4.6
	540	+3.5	0	.55	[illegible]	16.1	13.6	+11.6	+10.2	+8.8
11.1	480	7.1	+8.5	1.2	13.7	13.6	5.2	+6.2	+1.5	+.92
	540	4.8	+8.2	.55	12.9	20.5	10.3	+10.2	+4.7	+4.7
20.4	480	1.4	+2.2	1.2	0	10.0	9.7	1.5	3.4	6.2
	540	0	0	.55	0	14.9	13.6	+4.7	+3.3	.28
31.9	480	+6.3	0	3.4	2.2	5.5	2.3	4.3	8.9	9.2
	540	+7.5	+.58	3.6	1.4	10.5	6.7	.83	5.8	4.9

TABLE 38

COMBINATION #3 - SPINACH AND BEEF
61% - 39%

PERCENT LOSS OF CAROTENE

Percent Relative Humidity	Storage Periods								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	25.8	24.3	23.8	29.3	31.2	30.5	33.7	36.7	36.3
3	26.0	26.3	25.8	32.8	32.6	33.0	37.1	38.1	37.8
7	27.0	28.5	27.8	36.7	37.5	36.2	41.1	40.2	39.9
11.1	27.2	28.9	28.1	38.2	38.5	37.6	41.81	42.4	42.4
20.4	27.9	27.6	27.1	38.7	38.8	37.7	43.2	42.9	41.8
31.9	28.0	29.8	29.1	38.6	39.1	39.1	45.6	44.5	44.8

PERCENT LOSS OF MALONALDEHYDE

Percent Relative Humidity	Storage Periods								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	14.4	15.0	17.4	20.3	21.9	21.7	23.5	24.3	24.6
3	8.2	6.4	7.1	18.0	18.2	20.5	16.8	18.2	24.1
7	1.7	4.3	3.8	20.8	20.2	20.7	20.6	21.2	21.5
11.1	8.7	12.6	8.1	27.1	30.4	28.2	30.3	31.0	28.2
20.4	12.5	17.1	11.7	37.6	37.7	38.1	43.4	40.5	42.5
31.9	14.8	25.8	36.25	31.7	31.8	33.6	39.2	36.2	35.1

P_1 = 330 psi/30 sec
P_2 = 1100 psi/30 sec

TABLE 34

COMBINATION #3 - SPINACH AND BEEF
61% - 39%

PERCENT LOSS OF ASCORBIC ACID

Percent Relative Humidity	Storage Periods								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	48.2	48.5	48.6	52.9	53.9	54.0	63.3	62.0	61.4
3	49.2	48.9	49.5	66.1	65.1	65.0	74.2	72.7	71.5
7	50.5	50.7	50.1	72.3	64.9	64.9	83.5	81.5	81.0
11.1	52.9	52.9	51.3	78.8	77.0	77.1	85.8	85.3	87.2
20.4	59.4	56.7	59.2	85.8	85.2	85.2	89.0	87.6	87.0
31.9	61.1	62.1	61.3	87.7	87.8	87.9	91.6	92.1	91.6

P_1 = 330 psi/30 sec
P_2 = 1100 psi/30 sec

TABLE 35

COMBINATION #3 - BEEF AND SPINACH
39% - 61%

PERCENT LOSS OF REFLECTANCE

Percent Relative Humidity	mμ	Storage Periods 1 Month P_0	1 Month P_1	1 Month P_2	2 Months P_0	2 Months P_1	2 Months P_2	3 Months P_0	3 Months P_1	3 Months P_2
0	500	7.9	3.8	10.0	8.6	12.5	1.6	24.4	23.7	24.7
	530	+3.3	6.9	9.4	10.6	11.7	1.5	22.3	21.3	22.9
	655	+23.5	14.9	16.6	20.2	11.7	0	44.8	43.9	43.9
3	500	5.2	+39.4	2.5	+13.8	0	+17.5	30.2	32.5	32.8
	530	5.6	9.8	.58	+8.7	+1.5	+14.1	27.7	29.9	29.9
	665	5.3	12.8	10.4	+27.8	+6.9	+58.2	48.7	50.4	50.4
7	500	15.5	3.8	2.5	3.8	5.3	+22.2	26.9	26.9	25.9
	530	16.3	4.1	.58	5.9	4.6	+17.6	21.3	24.7	23.8
	655	12.3	8.5	9.6	+19.3	6.5	+46.7	44.8	44.8	45.3
11.1	500	0	6.1	2.5	8.6	12.5	+14.3	22.1	22.7	22.7
	530	0	6.9	.58	9.9	10.8	+11.2	20.1	19.5	19.8
	655	5.3	12.7	10.4	+6.7	12.2	+24.4	40.5	40.5	40.9
20.4	500	8.6	+2.4	2.5	+2.8	18.7	14.3	19.5	22.1	20.5
	530	8.2	6.9	.58	+4.0	17.6	11.7	17.7	19.5	18.3
	655	11.2	4.3	2.1	+19.3	30.4	24.4	33.2	34.5	33.2
31.9	500	6.9	+2.4	+2.5	8.6	5.3	+1.6	21.8	24.0	22.7
	530	6.6	6.9	+2.3	9.3	5.9	+1.5	19.2	21.9	19.2
	655	11.6	5.1	2.1	6.3	+21.7	+4.4	40.5	41.8	40.9

TABLE 36

COMBINATION #4 - SPINACH AND EGGS
25% - 75%

PERCENT GAIN OF MALONALDEHYDE

Percent Relative Humidity	Storage Periods								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	15.8	7.55	7.9	55.3	41.1	29.9	73.8	52.4	48.0
3	12.9	10.84	5.41	51.7	43.9	29.3	62.8	53.6	45.1
7	14.8	14.3	5.3	51.3	34.1	28.8	52.5	50.5	48.6
11.1	9.9	10.6	14.5	48.3	35.6	16.1	45.6	35.1	23.4
20.4	9.2	1.5	1.3	29.6	22.4	12.1	41.9	36.9	31.5
31.9	7.6	2.9	2.4	14.5	8.4	9.7	27.7	18.5	16.5

PERCENT LOSS OF CAROTENE

Percent Relative Humidity	Storage Period								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	25.7	25.0	24.2	32.2	31.2	32.3	37.2	36.5	36.0
3	25.6	25.5	24.8	32.0	30.9	34.5	37.6	36.9	36.5
7.0	26.6	27.3	27.4	34.2	35.6	35.3	39.8	39.8	38.9
11.1	28.3	27.7	27.4	34.0	35.8	36.5	43.8	41.8	41.1
20.4	28.8	28.2	29.0	34.7	36.1	37.6	45.5	44.4	43.0
31.9	29.0	28.6	28.6	36.0	36.8	38.2	48.9	48.6	45.9

P_1 = 500 psi/30 sec
P_2 = 1000 psi/30 sec

TABLE 37

COMBINATION #4 - SPINACH AND EGGS
25% - 75%

PERCENT LOSS OF ASCORBIC ACID

Percent Relative Humidity	Storage Periods								
	1 Month			2 Months			3 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	52.6	49.9	49.9	58.1	55.3	56.1	69.2	68.0	66.7
3	53.1	53.3	52.1	65.5	62.1	65.8	75.4	74.2	71.9
7	55.1	55.5	55.5	67.4	67.6	66.7	77.7	75.4	74.3
11.1	57.5	57.4	57.4	73.3	73.6	71.0	81.0	77.5	88.8
20.4	62.8	62.8	59.5	84.7	80.5	83.2	88.7	88.7	88.7
31.9	64.7	64.6	62.5	88.4	86.3	86.5	93.2	90.9	89.8

P_1 = 500 psi/30 sec
P_2 = 1000 psi/30 sec

TABLE 38

COMBINATION #4 - SPINACH AND EGGS
25% - 75%

PERCENT GAIN OF REFLECTANCE

Percent Relative Humidity	mμ	Storage Periods: 1 Month F_0	F_1	F_2	2 Months F_0	F_1	F_2	3 Months F_0	F_1	F_2
0	500	39.1	85.7	95.1	-1.8	-12.3	-11.3	-19.9	15.4	6.3
	530	38.4	79.16	100.0	3.9	-9.2	-8.7	10.2	13.1	3.5
	655	72.8	90.7	96.4	-13.0	-21.7	-18.9	15.3	16.5	9.5
3	500	65.2	83.3	76.5	7.8	-4.7	-0	15.4	16.6	4.5
	530	61.15	79.2	86.4	13.4	-1.4	2.0	12.6	14.9	1.6
	655	82.1	108.6	96.4	-4.8	-13.0	-7.6	15.3	14.4	5.7
7	500	60.8	80.9	91.2	6.8	-.94	0	21.4	21.7	9.0
	530	57.6	75.8	95.5	12.1	3.4	2.3	18.2	18.2	5.9
	655	63.6	80.0	96.4	-8.2	-10.8	-9.9	20.5	20.4	12.4
11.1	500	73.0	88.1	87.7	1.8	-9.4	-12.9	8.3	-19.9	-4.5
	530	67.3	80.4	90.9	7.2	-5.7	-11.0	5.6	8.0	-7.2
	655	69.8	100.0	85.0	-10.6	-19.8	-21.2	15.3	16.5	5.8
20.4	500	70.9	83.3	91.2	-2.5	-2.5	-4.8	6.8	13.1	4.5
	530	65.3	75.8	95.5	0	0	-4.3	5.6	10.9	1.3
	655	88.3	100.0	92.9	-17.3	-15.6	-15.3	4.4	10.8	12.4
31.9	500	60.8	95.2	92.2	6.8	-4.7	3.5	6.8	-17.2	0
	530	57.7	87.5	90.9	11.5	-1.4	5.2	4.3	10.2	-2.4
	655	69.5	108.6	100.0	-8.2	-14.8	-4.1	4.4	7.6	-1.6

TABLE 39

COMBINATION #5 - BEEF AND POTATOES
55% - 45%

PERCENT GAIN OF MALONALDEHYDE*

Percent Relative Humidity	Storage Period: 1 Month P_0	1 Month P_1	1 Month P_2	2 Months P_0	2 Months P_1	2 Months P_2	3 Months P_0	3 Months P_1	3 Months P_2
0	8.5	11.0	10.7	0.37	6.2	0.78	-14.5	-14.6	-9.1
3	9.7	7.5	17.6	11.7	17.2	15.1	6.0	7.7	4.3
7	6.5	5.4	5.2	10.9	10.9	14.3	-12.5	-10.6	-13.5
11.1	3.5	3.9	2.7	-3.2	-1.1	-2.9	-15.9	-12.5	-15.1
20.4	2.7	1.2	2.1	-5.2	-3.0	1.6	-15.1	-19.5	-16.8
31.9	0.04	0.40	0.58	-9.2	-6.0	-4.7	-21.7	-24.2	-20.6

* All show gain of malonaldehyde except those denoted by minus sign

FREE FATTY ACID - CALCULATED AS % OLEIC ACID

Percent Relative Humidity	Storage Periods: 1 Month P_0	1 Month P_1	1 Month P_2	2 Months P_0	2 Months P_1	2 Months P_2	3 Months P_0	3 Months P_1	3 Months P_2
0	1.46	1.51	1.42	1.52	1.56	1.58	1.59	1.60	1.65
3	1.45	1.35	1.41	1.46	1.46	1.48	1.42	1.52	1.52
7.0	1.39	1.47	1.35	1.49	1.52	1.55	1.58	1.52	1.56
11.1	1.46	1.48	1.47	1.39	1.33	1.42	1.42	1.38	1.44
20.4	1.46	1.48	1.47	1.41	1.43	1.43	1.50	1.42	1.43
31.9	1.44	1.46	1.46	1.61	1.66	1.62	1.62	1.59	1.60

* Initial Control - 1.286 % Oleic Acid

P_1 = 3000 psi/30 sec
P_2 = 4000 psi/30 sec

TABLE 40

COMBINATION #5 - BEEF AND POTATOES
55% - 45%

PERCENT LOSS OF REFLECTANCE

Percent Relative Humidity	mμ	Storage Periods: 1 Month			2 Months			3 Months		
		P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	480	8.4	10.8	7.3	4.1	12.1	2.1	6.5	7.3	2.9
	540	8.0	10.5	7.7	3.0	11.8	1.9	4.9	4.9	.79
3	480	3.8	10.8	10.3	21.8	30.2	21.8	+3.7	+11.8	+21.1
	540	3.2	10.1	10.1	21.5	29.3	21.2	+2.7	.38	+19.4
7	480	4.2	8.6	7.3	19.3	28.2	18.5	+4.9	+6.9	+14.8
	540	2.0	8.5	7.7	19.6	26.9	16.2	+3.4	+4.9	+13.1
11.1	480	0	6.0	4.7	19.3	28.2	13.6	+3.7	+4.5	+10.6
	540	0	4.1	4.5	16.5	27.8	11.5	+2.7	+3.4	+10.3
20.4	480	.84	7.3	7.3	16.5	28.2	17.7	13.8	11.4	8.9
	540	4.0	7.7	7.7	15.4	27.8	16.2	10.7	8.8	5.2
31.9	480	4.6	3.0	+.86	16.1	25.4	14.4	6.1	4.06	.42
	540	6.0	1.6	+1.2	12.7	22.8	11.5	1.9	+12.5	+3.9

TABLE 41

COMBINATION #6 - CABBAGE AND CARROTS
82% - 18%

PERCENT LOSS OF ASCORBIC ACID

Percent Relative Humidity	Storage Periods								
	2 Months			3 Months			4 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	14.95	13.98	14.18	12.74	17.63	12.77	*	31.59	34.11
3.0	16.08	16.50	16.50	21.37	21.53	21.63	*	39.36	39.36
7.0	22.75	20.24	20.24	30.50	57.47	57.37	*	53.28	59.94
11.1	32.06	28.35	26.60	42.50	45.83	45.83	*	68.32	62.06
20.4	38.12	36.35	36.42	45.80	57.57	56.65	*	68.02	68.02
31.9	47.12	50.31	47.54	58.54	60.46	66.74	*	82.25	82.25

* Values not available

PERCENT LOSS OF CAROTENE

Percent Relative Humidity	Storage Periods								
	2 Months			3 Months			4 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	39.6	39.7	35.0	34.65	46.05	44.1	*	46.5	47.1
3.0	45.4	59.5	57.4	48.37	66.0	63.8	*	67.3	69.5
7.0	39.0	32.8	43.3	50.0	58.5	60.71	*	66.9	66.7
11.1	48.7	(+12.6)	53.3	52.30	54.5	52.3	*	64.95	66.9
20.4	56.5	59.5	55.0	63.72	65.8	63.6	*	72.0	69.0
31.9	55.9	55.1	76.5	58.37	65.1	60.5	*	79.6	79.6

$$\frac{\text{Original Carotene - Residual}}{\text{Original Carotene}} \times 100 = \text{\% Carotene lost}$$

P_1 = 300 psi/30 sec.

P_2 = 500 psi/30 sec.

TABLE 42

COMBINATION #6 - CABBAGE AND CARROTS
82% - 18%

PERCENT LOSS OF REFLECTANCE

Percent Relative Humidity	mμ	Storage Periods								
		2 Months			3 Months			4 Months		
		P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	525	0	14.1	6.6	2.4	7.1	2.9	*	16.8	12.1
	560	0	11.1	3.8	3.3	5.9	2.3	*	13.7	10.8
	600	.41	9.4	3.6	3.4	5.3	2.5	*	12.1	8.0
3	525	5.3	19.2	7.9	12.6	14.6	10.1	*	25.6	17.5
	560	+4.3	17.3	5.1	9.1	12.9	8.2	*	22.1	45.9
	600	+3.2	15.3	4.8	8.5	10.8	7.4	*	20.0	12.4
7	525	+8.3	12.8	7.9	11.4	20.6	20.8	*	39.2	28.4
	560	+7.2	9.9	5.1	8.9	16.8	17.6	*	33.6	24.4
	600	+6.1	8.8	3.6	4.2	13.2	14.2	*	29.3	19.7
11.1	525	0	10.3	9.9	10.2	9.0	11.7	*	24.3	18.3
	560	.43	7.4	7.6	8.8	7.3	10.1	*	20.6	45.9
	600	.83	4.7	6.0	6.8	6.6	9.1	*	17.9	12.4
20.4	525	1.5	21.8	15.1	11.9	16.9	16.4	*	33.6	31.5
	560	1.2	18.5	11.4	9.7	12.9	14.8	*	28.2	27.5
	600	1.4	16.5	8.4	6.4	11.8	12.4	*	24.3	21.9
31.9	525	6.4	24.3	15.1	18.3	30.2	33.0	*	43.2	35.5
	560	5.4	19.8	11.4	16.1	25.6	28.4	*	37.4	30.6
	600	3.6	16.5	8.4	11.9	21.1	23.8	*	32.1	24.8

* Values not available

TABLE 43

COMBINATION #7 - CABBAGE AND CARROTS
64% - 36%

PERCENT LOSS OF ASCORBIC ACID

Percent Relative Humidity	Storage Periods								
	2 Months			3 Months			4 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	9.14	5.85	5.85	16.06	20.67	19.28	*	48.67	48.57
3.0	24.60	33.26	39.47	32.01	51.23	37.81	*	45.90	50.16
7.0	31.43	27.05	27.05	39.23	48.78	48.67	*	61.24	61.24
11.1	36.42	31.67	28.50	47.72	60.71	40.14	*	65.93	71.46
20.4	45.19	54.46	54.45	57.50	72.53	65.71	*	82.11	79.34
31.9	60.54	84.05	84.05	76.95	78.9	85.95	*	87.44	88.08

* Values not available

PERCENT LOSS OF CAROTENE

Percent Relative Humidity	Storage Periods								
	2 Months			3 Months			4 Months		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
0	35.20	31.83	50.10	39.10	38.50	50.90	*	46.60	46.50
3.0	47.10	57.10	67.70	54.20	68.10	55.70	*	59.90	60.00
7.0	50.90	39.90	47.30	54.20	42.00	48.90	*	43.10	45.30
11.1	55.20	36.30	38.50	60.60	37.90	34.90	*	45.00	45.00
20.4	57.50	47.90	50.50	63.90	50.60	52.80	*	55.00	57.80
31.9	57.10	51.10	46.80	64.80	48.80	48.80	*	55.00	57.80

$$\frac{\text{Original Carotene - Residual}}{\text{Original Carotene}} \times 100 = \text{\% Carotene lost}$$

P_1 = 300 psi/sec.

P_2 = 500 psi/sec.

TABLE 44

COMBINATION #7 - CABBAGE AND CARROTS
64% - 36%

PERCENT LOSS OF REFLECTANCE

Percent Relative Humidity	mμ	Storage Periods 2 Months P_0	P_1	P_2	3 Months P_0	P_1	P_2	4 Months P_0	P_1	P_2
0	525	14.3	3.7	5.3	6.9	12.4	16.6	*	28.4	19.4
	560	12.6	2.7	4.6	6.4	10.4	14.1	*	23.8	16.0
	600	10.9	1.4	4.6	5.5	7.8	11.6	*	19.6	12.7
3	525	10.4	8.5	10.8	6.9	18.9	17.6	*	15.3	11.9
	560	11.2	7.3	9.5	5.0	-16.6	15.4	*	12.7	10.0
	600	8.2	5.9	8.1	1.9	14.6	13.0	*	10.9	8.8
7	525	14.3	13.2	12.0	1.8	27.0	19.2	*	31.5	30.6
	560	12.2	10.3	16.4	2.0	24.0	16.8	*	26.7	27.0
	600	9.6	7.7	8.9	1.9	20.0	14.1	*	21.7	22.5
11.1	525	17.1	8.4	9.6	9.5	18.9	14.1	*	16.9	26.9
	560	14.6	6.8	8.4	25.0	16.3	11.6	*	14.2	24.1
	600	12.2	5.3	7.2	6.7	13.9	9.6	*	10.9	19.9
20.4	525	17.4	12.8	10.8	21.8	24.0	17.7	*	32.2	29.4
	560	15.6	10.8	9.6	16.7	20.3	14-1	*	27.7	25.9
	600	12.9	8.6	8.1	26.6	16.0	11.9	*	21.9	22.5
31.9	525	16.4	18.3	20.6	20.0	30.7	23.1	*	36.9	35.8
	560	14.9	15.2	17.2	16.4	36.2	20.3	*	33.1	31.4
	600	11.2	11.4	14.9	28.1	29.7	16.3	*	27.4	26.4

* Values not available

TABLE 47

BEEF & SPINACH #1 (FLAVOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	5%
Total	1,781.9615	647				
Tasters	927.1698	8	115.8962	146.816	2.511	1.938
Treatments	250.4059	71				
Compression	27.5032	2	13.7516	11.220	5.390	3.316
Storage Period	55.2640	3	18.4213	15.030	4.510	2.922
R. H.	38.0634	5	7.6127	6.211	3.699	2.534
R.H. x Storage Period	48.2637	15	3.2176	2.625	2.700	2.015
R.H. x Compression	10.5893	10	1.0589	0.864	2.979	2.165
Storage Period x Compression	33.9536	6	5.6589	4.617	3.474	2.421
R.H. x Storage Period x Compression	36.7687	30	1.2256			
Interaction with Tasters		568				
Tasters x R.H.	67.6450	40	1.6911	2.142	1.592	1.394
Tasters x Storage Period	88.9166	24	3.7049	4.693	1.791	1.517
Tasters x Compression	62.5802	16	3.9113	4.955	2.007	1.647
Tasters x R.H. x Storage Period Tasters x R.H. x Compression Tasters x Storage Period x Compression Tasters x R.H. x Compression x Storage Period	385.2440	488	0.7894			

TABLE 48

BEEF & SPINACH #1 (ODOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	1,222.6111	647				
Tasters	616.3055	8	77.0382	104.785	2.511	1.938
Treatments	108.6111	71				
Compression	10.7315	2	5.3648	12.069	5.390	3.316
Storage Period	25.2160	3	8.4053	18.905	4.510	2.922
R. H.	20.5370	5	4.1074	9.238	3.699	2.534
R.H. x Storage Period	25.3025	15	1.6868	3.794	2.700	2.015
R.H. x Compression	4.0093	10	0.4009	0.902	2.979	2.165
Storage Period x Compression	9.4784	6	1.5797	3.553	3.474	2.421
R.H. x Storage Period x Compression	13.3364	30	0.4446			
Interaction with Tasters		568				
Tasters x R.H.	44.4353	40	1.1109	1.511	1.592	1.394
Tasters x Storage Period	83.8674	24	3.4945	4.753	1.791	1.517
Tasters x Compression	87.2408	16	5.4526	7.417	2.007	1.647
Tasters x R.H. x Storage Period						
Tasters x R.H. x Compression						
Tasters x Storage Period x Compression	358.7847	488	0.7352			
Tasters x R.H. x Compression x Storage Period						

TABLE 49

BEEF AND SPINACH #1

EFFECT OF STORAGE PERIOD & RELATIVE HUMIDITY ON FLAVOR

Storage Period (Mo.)	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Storage Period
0	6.0	5.7	6.0	5.9	6.4	5.9	6.0
1	6.9	7.0	6.9	6.6	6.3	6.4	6.7
2	6.6	6.9	6.8	6.5	5.3	6.1	6.4
3	6.2	6.4	6.1	6.2	5.3	5.8	6.0
Means of R. H.	6.4	6.5	6.5	6.3	5.8	6.1	

Interaction - SD
Effect of Storage Period - HSD
Effect of R. H - HSD

TABLE 50

EFFECT OF STORAGE PERIOD & RELATIVE HUMIDITY ON ODOR

Storage Period (Mo.)	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Storage Period
0	6.0	5.9	6.0	5.8	6.3	6.0	6.0
1	6.7	6.7	6.7	6.4	6.3	6.3	6.5
2	6.5	6.6	6.5	6.3	5.4	6.1	6.2
3	6.4	6.4	6.2	6.1	5.7	5.9	6.1
Means of R. H.	6.4	6.4	6.3	5.2	5.9	6.1	

Interaction - HSD
Effect Storage Period - HSD
Effect of R. H. - HSD

TABLE 51

BEEF AND SPINACH #1

EFFECT OF STORAGE PERIOD & COMPRESSION ON FLAVOR

Compression Level	Means of Main Effects Storage Period (No.) 0	1	2	3	Means of Compression Levels
P_0	5.9	6.7	6.3	5.3	6.0
P_1	6.2	6.8	6.4	6.7	6.5
P_2	5.8	6.6	6.3	6.1	6.2
Means of Storage Period	6.0	6.7	6.4	6.0	

Interaction - HSD
Effect of Compression Levels - HSD
Effect of Storage Periods - HSD

TABLE 52

EFFECT OF STORAGE PERIOD & COMPRESSION ON ODOR

Compression Level	Means of Main Effects Storage Period (No.) 0	1	2	3	Means of Compression Level
P_0	6.1	6.4	6.1	5.7	6.4
P_1	6.0	6.7	6.3	6.5	6.4
P_2	5.9	6.5	6.3	6.1	6.2
Means of Storage Period	6.0	6.5	6.2	6.1	

Interaction -HSD
Effect of Compression Levels - HSD
Effect of Storage Periods - HSD

TABLE 53

BEEF AND EGGS #2 (FLAVOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	1,346.3144	647				
Tasters	566.8838	8	70.8605	92.786	2.511	1.938
Treatments	131.8700	71				
Compression	3.0598	2	1.5299	2.785	5.390	3.316
Storage Period	36.8638	3	12.2879	22.370	4.510	2.922
R. H.	34.0829	5	6.8166	12.410	3.699	2.534
R.H. x Storage Period	21.2196	15	1.4146	2.575	2.700	2.015
R.H. x Compression	10.1995	10	1.0200	1.857	2.979	2.165
Storage Period x Compression	9.9649	6	1.6608	3.023	3.474	2.421
R.H. x Storage Period x Compression	16.4795	30	0.5493			
Interaction with Tasters		568				
Tasters x R.H.	35.5977	40	0.8899	1.165	1.592	1.394
Tasters x Storage Period	221.6224	24	9.2343	12.092	1.791	1.517
Tasters x Compression	17.6625	16	1.1039	1.446	2.007	1.647
Tasters x R.H. x Storage Period						
Tasters x R.H. x Compression						
Tasters x Storage Period x Compression	372.6780	488	0.7637			
Tasters x R.H. x Compression x Storage Period						

TABLE 34

BEEF AND EGGS #2 (ODOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	1,487.2577	647				
Tasters	927.2994	8	115.9124	217.349	2.511	1.938
Treatments	88.3688	71				
Compression	12.0123	2	6.0062	11.380	5.390	3.316
Storage Period	9.5231	3	3.1744	6.014	4.510	2.922
R. H.	10.1373	5	2.0275	3.841	3.699	2.534
R.H. x Storage Period	20.1899	15	1.3460	2.550	2.700	2.015
R.H. x Compression	4.9692	10	0.4969	0.942	2.979	2.165
Storage Period x Compression	15.7038	6	2.6173	4.959	3.474	2.421
R.H. x Storage Period x Compression	15.8332	30	0.5278			
Interaction with Tasters		568				
Tasters x R.H.	32.0710	40	0.8018	1.504	1.592	1.394
Tasters x Storage Period	162.7130	24	6.7797	12.713	1.791	1.517
Tasters x Compression	16.5710	16	1.0357	1.942	2.007	1.647
Tasters x R.H. x Storage Period						
Tasters x R.H. x Compression						
Tasters x Storage Period x Compression	260.2349	488	0.5333			
Tasters x R.H. x Compression x Storage Period						

TABLE 55

BEEF AND EGG #2

EFFECT OF STORAGE PERIOD & RELATIVE HUMIDITY ON FLAVOR

Storage Period (Mo.)	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Storage
0	6.1	6.3	6.5	6.4	6.0	6.2	6.3
1/2	6.3	6.4	6.5	6.5	6.4	6.3	6.4
1	6.9	6.9	6.9	6.6	6.3	6.1	6.6
3	6.4	6.2	6.4	6.0	5.6	5.1	5.9
Means of R. H.	6.4	6.5	6.6	6.4	6.1	5.9	

Interaction - SD
Effect of Storage Period - HSD
Effect of R. H. - HSD

TABLE 56

EFFECT OF STORAGE PERIOD & RELATIVE HUMIDITY ON ODOR

Storage Period (Mo.)	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Storage Period
0	6.0	6.1	6.4	6.3	6.0	6.2	6.2
1/2	6.0	6.2	6.0	6.3	6.2	6.3	6.1
1	6.5	6.6	6.3	6.4	6.3	5.7	6.3
3	6.1	6.1	6.1	6.2	5.8	5.5	6.0
Means of R. H.	6.2	6.2	6.2	6.3	6.1	5.9	

Interaction - SD
Effect of Storage Peirod - HSD
Effect of R. H. - HSD

TABLE 57

BEEF AND EGG #2

EFFECT OF STORAGE PERIOD & COMPRESSION ON ODOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	1/2	1	3	Means of Compression Levels
P_0	6.4	6.5	6.2	6.3	6.3
P_1	6.0	5.9	6.4	6.0	6.1
P_2	6.1	6.1	6.4	5.6	6.0
Means of Storage Period	6.2	6.1	6.3	6.0	

Interaction - HSD
Effect of Compression Level - HSD
Effect of Storage Period - HSD

TABLE 58

BEEF & SPINACH .3 (FLAVOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	1,697.1096	647				
Tasters	672.1235	8	84.0154	83.407	2.511	1.938
Treatments	237.5540	71				
Compression	9.6327	2	4.8164	4.113	5.390	3.316
Storage Period	83.3627	3	27.7876	23.732	4.510	2.922
R. H.	67.4337	5	13.4867	11.518	3.699	2.534
R.H. x Storage Period	28.9057	15	1.9271	1.646	2.700	2.015
R.H. x Compression	5.4043	10	0.5404	0.462	2.979	2.165
Storage Period x Compression	7.6883	6	1.2814	1.094	3.474	2.421
R.H. x Storage Period x Compression	35.1266	30	1.1709			
Interaction with Tasters		568				
Tasters x R.H.	92.8024	40	2.3201	2.303	1.592	1.394
Tasters x Storage Period	167.3456	24	6.9727	6.922	1.791	1.517
Tasters x Compression	35.7284	16	2.2330	2.217	2.007	1.647
Tasters x R.H. x Storage Period; Tasters x R.H. x Compression; Tasters x Storage Period x Compression; Tasters x R.H. x Compression x Storage Period	491.5557	488	1.0073			

TABLE 59

BEEF & SPINACH #3 (ODOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	5%
Total	1,182.8750	647				
Tasters	595.5278	8	74.4410	146.509	2.511	1.938
Treatments	119.7639	71				
Compression	3.2500	2	1.6250	3.301	5.390	3.316
Storage Period	50.6713	3	16.8904	34.309	4.510	2.922
R. H.	28.2176	5	5.6435	11.464	3.599	2.534
R.H. x Storage Period	14.5787	15	0.9719	1.974	2.700	2.015
R.H. x Compression	1.0463	10	0.1046	0.213	2.979	2.165
Storage Period x Compression	7.2315	6	1.2053	2.448	3.474	2.421
R.H. x Storage Period x Compression	14.7685	30	0.4923			
Interaction with Tasters		568				
Tasters x R.H.	41.7123	40	1.0428	2.052	1.592	1.394
Tasters x Storage Period	134.1759	24	5.5907	11.003	1.791	1.517
Tasters x Compression	43.7222	16	2.7326	5.378	2.007	1.647
Tasters x R.H. x Storage Period						
Tasters x R.H. x Compression						
Tasters x Storage Period x Compression	247.9723	488	0.5081			
Tasters x R.H. x Compression x Storage Period						

TABLE 80

SPINACH & EGGS #4 (FLAVOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	5%
Total	1,399.1701	647				
Tasters	876.5034	8	109.5629	201.848	2.511	1.938
Treatments	77.8368	71				
Compression	0.5220	2	0.2610	0.916	5.390	3.316
Storage Period	3.5034	3	1.1678	4.098	4.510	2.922
R.H.	9.1053	5	1.8211	6.390	3.609	2.534
R.H. x Storage Period	7.9317	15	0.5288	1.855	2.700	2.015
R.H. x Compression	19.0428	10	1.9043	6.682	2.979	2.165
Storage Period x Compression	29.1817	6	4.8636	17.065	3.474	2.421
R.H. x Storage Period x Compression	8.5499	30	0.2850			
Interaction with Tasters		568				
Tasters x R.H.	64.7281	40	1.6182	2.981	1.592	1.394
Tasters x Storage Period	93.4966	24	3.8957	7.177	1.791	1.517
Tasters x Compression	21.7280	16	1.3580	2.502	2.007	1.647
Tasters x R.H. x Storage Period Tasters x R.H. x Compression Tasters x Storage Period x Compression Tasters x R.H. x Compression x Storage Period	264.8772	488	0.5428			

TABLE 61

SPINACH & EGGS #4 (ODOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	5%
Total	1,236.0438	647				
Tasters	828.4327	8	103.5541	204.774	2.511	1.938
Treatments	13.8216	71				
Compression	1.6271	2	0.8136	2.248	5.390	3.316
Storage Period	20.5500	3	6.8500	18.928	4.510	2.922
R. H.	18.4512	5	3.6902	10.197	3.699	2.534
R.H. x Storage Period	6.8945	15	0.4596	1.270	2.700	2.015
R.H. x Compression	4.0211	10	0.4021	1.111	2.979	2.165
Storage Period x Compression	9.2000	6	1.5333	4.236	3.474	2.421
R.H. x Storage Period x Compression	10.8550	30	0.3619			
Interaction with Tasters		568				
Tasters x R.H.	41.1599	40	1.0290	2.035	1.592	1.394
Tasters x Storage Period	96.2833	24	4.0118	7.933	1.791	1.517
Tasters x Compression	9.5673	16	0.5980	1.183	2.007	1.647
Tasters x R.H. x Storage Period; Tasters x R.H. x Compression; Tasters x Storage Period x Compression; Tasters x R.H. x Compression x Storage Period	246.7790	488	0.5057			

TABLE 62

SPINACH-EGG DISC #4

EFFECT OF COMPRESSION AND RELATIVE HUMIDITY ON FLAVOR

Compression Level	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.8	Means of Compression Level
P_0	6.4	6.4	6.6	6.5	6.2	6.3	6.4
P_1	6.4	6.4	6.6	6.3	6.1	6.1	6.3
P_2	6.7	6.6	6.6	6.2	6.1	5.8	6.3
Means of R. H.	6.5	6.4	6.6	6.3	6.2	6.1	

Interaction - HSD
Effect of Compression - NS
Effect of R. H. - HSD

TABLE 63

SPINACH AND EGG #4

EFFECT OF STORAGE PERIOD & COMPRESSION ON ODOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	1	2	3	Means of Compression Levels
P_0	6.2	6.2	6.3	5.9	6.2
P_1	6.2	6.4	6.1	6.0	6.2
P_2	6.1	6.5	5.9	5.7	6.1
Means of Storage Period	6.2	6.4	6.1	5.9	

Interaction - HSD
Effect of Compression Level - NS
Effect of Storage Period - HSD

TABLE 64

EFFECT OF STORAGE PERIOD & COMPRESSION ON FLAVOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	1	2	3	Means of Compression Levels
P_0	6.5	6.1	6.7	6.2	6.4
P_1	6.3	6.5	6.1	6.5	6.3
P_2	6.2	6.8	6.2	6.2	6.3
Means of Storage Period	6.3	6.5	6.3	6.3	

Interaction - HSD
Effect of Compression Level - NS
Effect of Storage Period - SD

TABLE 65

BEEF & POTATOES #5 (ODOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	5%
Total	926.4444	647				
Tasters	386.0277	8	48.2535	100.738	2.511	1.938
Treatments	49.7777	71				
Compression	4.7777	2	2.3889	8.741	5.380	3.316
Storage Period	5.9753	3	1.9918	7.288	4.510	2.922
R. H.	2.8518	5	0.5704	2.087	3.899	2.534
R.H. x Storage Period	13.2469	15	0.8831	3.231	2.700	2.015
R.H. x Compression	4.0371	10	0.4037	1.477	2.979	2.165
Storage Period x Compression	10.6914	6	1.7819	6.520	3.474	2.421
R.H. x Storage Period x Compression	8.1975	30	0.2733			
Interaction with Tasters		568				
Tasters x R.H.	15.8982	40	0.3975	0.830	1.592	1.394
Tasters x Storage Period	192.7747	24	8.0323	16.769	1.791	1.517
Tasters x Compression	48.2223	16	3.0139	6.292	2.007	1.647
Tasters x R.H. x Storage Period Tasters x R.H. x Compression Tasters x Storage Period x Compression Tasters x R.H. x Compression x Storage Period	233.7438	488	0.4790			

TABLE 66

BEEF & POTATOES #5 (FLAVOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	962.2207	647				
Tasters	368.8735	8	46.1092	111.726	2.511	1.938
Treatments	57.5540	71				
Compression	6.9013	2	3.4507	10.716	5.390	3.316
Storage Period	11.7207	3	3.9069	12.133	4.510	2.922
R. H.	2.0263	5	0.4053	1.259	3.699	2.534
R.H. x Storage Period	11.2985	15	0.7526	2.337	2.700	2.015
R.H. x Compression	1.8209	10	0.1821	0.566	2.979	2.165
Storage Period x Compression	14.1357	6	2.3560	7.317	3.474	2.421
R.H. x Storage Period x Compression	9.6606	30	0.3220			
Interaction with Tasters		568				
Tasters x R.H.	27.5709	40	0.6893	1.670	1.592	1.394
Tasters x Storage Period	266.0154	24	11.0840	26.857	1.791	1.517
Tasters x Compression	40.8209	16	2.5513	6.182	2.007	1.647
Tasters x R.H. x Storage Period; Tasters x R.H. x Compression; Tasters x Storage Period x Compression; Tasters x R.H. x Compression x Storage Period	201.36 0	488	0.4127			

TABLE 67

BEEF-POTATO DISC #5

EFFECT OF R. H. AND STORAGE PERIOD ON FLAVOR

Storage Period (Mo.)	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Storage Period
0	6.1	6.0	6.3	6.2	6.4	6.1	6.2
1	6.7	6.5	6.6	6.6	6.4	6.4	6.5
2	6.6	6.7	6.6	6.4	6.2	6.3	6.5
3	6.1	6.5	6.5	6.3	6.4	6.4	6.4
Means of R. H.	6.4	6.4	6.5	6.4	6.4	6.3	

Interaction - SD
Effect of Storage Period - HSD
Effect of R. H. - NS

TABLE 68

EFFECT OF R. H. AND STORAGE PERIOD ON ODOR

Storage Period (Mo.)	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Storage Period
0	6.0	6.0	6.5	6.3	6.6	6.4	6.3
1	6.4	6.4	6.4	6.3	6.2	6.4	6.4
2	6.7	6.7	6.6	6.4	6.5	6.4	6.5
3	6.4	6.8	6.6	6.3	6.5	6.3	6.5
Means of R. H.	6.4	6.5	6.5	6.3	6.5	6.4	

Interaction - HSD
Effect of Storage Period - HSD
Effect of R. H. - NS

TABLE 69

BEEF-POTATO DISC #5

EFFECT OF STORAGE PERIOD & COMPRESSION ON FLAVOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	2	3	4	Means of Compression Levels
P_0	6.0	6.6	6.4	6.0	6.2
P_1	6.3	6.4	6.4	6.7	6.4
P_2	6.2	6.7	6.6	6.4	6.5
Means of Storage Periods	6.2	6.5	6.5	6.4	

Interaction- HSD
Effect of Compression Level - HSD
Effect of Storage Period - HSD

TABLE 70

EFFECT OF STORAGE PERIOD & COMPRESSION ON ODOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	2	3	4	Means of Compression Levels
P_0	6.3	6.5	6.7	6.3	6.5
P_1	6.2	6.2	6.2	6.6	6.3
P_2	6.4	6.4	6.7	6.6	6.5
Means of Storage Period	6.3	6.4	6.5	6.5	

Interaction - HSD
Effect of Compression Level - HSD
Effect of Storage Period - HSD

TABLE 71

CARROT & CABBAGE # 6 (FLAVOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	2,154.8133	647				
Tasters	1,386.4383	8	173.3048	205.801	2.511	1.938
Treatments	161.7022	71				
Compression	11.0772	2	5.5386	7.539	5.390	3.316
Storage Period	25.6096	3	8.5365	11.619	4.510	2.922
R. H.	20.9152	5	4.1830	5.694	3.699	2.534
R.H. x Storage Period	34.7329	15	2.3155	3.152	2.700	2.015
R.H. x Compression	6.1820	10	0.6182	0.841	2.979	2.165
Storage Period x Compression	41.1450	6	6.8575	9.334	3.474	2.421
R.H. x Storage Period x Compression	22.0403	30	0.7347			
Interaction with Tasters		568				
Tasters x R.H.	67.7098	40	1.6928	2.010	1.592	1.394
Tasters x Storage Period	107.5987	24	4.4833	5.324	1.791	1.517
Tasters x Compression	20.4228	16	1.2764	1.516	2.007	1.647
Tasters x R.H. x Storage Period						
Tasters x R.H. x Compression						
Tasters x Storage Period x Compression	410.9 .5	488	0.8421			
Tasters x R.H. x Compression x Storage Period						

TABLE 72

CARROT & CABBAGE #6 (ODOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	862.3457	647				
Tasters	406.0401	8	50.7550	135.854	2.511	1.939
Treatments	108.7901	71				
Compression	1.8735	2	0.9368	1.617	5.390	3.316
Storage Period	43.8395	3	14.6132	25.217	4.510	2.922
R. H.	3.9568	5	0.7914	1.366	3.699	2.534
R.H. x Storage Period	12.6235	15	0.8416	1.452	2.700	2.015
R.H. x Compression	7.2932	10	0.7293	1.258	2.979	2.165
Storage Period x Compression	21.8179	6	3.6363	6.275	3.474	2.421
R.H. x Storage Period x Compression	17.3857	30	0.5795			
Interaction with Tasters		568				
Tasters x R.H.	27.3488	40	0.6837	1.830	1.592	1.394
Tasters x Storage Period	84.5772	24	3.5241	9.433	1.791	1.517
Tasters x Compression	53.2821	16	3.3301	8.914	2.007	1.647
Tasters x R.H. x Storage Period Tasters x R.H. x Compression Tasters x Storage Period x Compression Tasters x R.H. x Compression x Storage Period	182.3074	488	0.3736			

TABLE 73

CARROT-CABBAGE #6

EFFECT OF R. H. AND STORAGE PERIOD ON FLAVOR

Storage Period (No.)	Means of Main Effects Relative Humidity(%)						Means of Storage Period
	0	3.0	7.0	11.1	20.4	31.9	
0	5.2	4.7	4.5	4.4	5.1	5.0	4.8
2	5.4	5.3	5.3	5.2	5.1	4.8	5.1
3	5.3	4.7	4.6	5.1	4.7	4.5	4.8
4	8.3	5.6	5.5	5.4	5.2	4.6	5.3
Means of R.H.	5.3	5.1	5.0	5.0	5.0	4.7	

Interaction - HSD
Effect of Storage Period - HSD
Effect of R. H. - HSD

TABLE 74

CARROT-CABBAGE #6

EFFECT OF STORAGE PERIOD & COMPRESSION ON FLAVOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	2	3	4	Means of Compression Levels
P_0	4.9	5.8	5.1	4.9	5.2
P_1	4.8	4.8	4.8	5.5	5.0
P_2	4.7	4.9	4.6	5.4	4.9
Means of Storage Period	4.8	5.1	4.8	5.3	

Interaction - HSD
Effect of Compression Level - HSD
Effect of Storage Period - HSD

TABLE 75

EFFECT OF STORAGE PERIOD & COMPRESSION ON ODOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	2	3	4	Means of Compression Levels
P_0	5.0	5.6	4.9	5.3	5.2
P_1	4.8	5.3	5.3	5.8	5.3
P_2	4.9	5.1	5.3]	5.8	5.3
Means of Storage Period	4.9	5.3	5.2	5.6	

Interaction - HSD
Effect of Compression Level - NS
Effect of Storage Period - HSD

TABLE 76

CARROT & CABBAGE #7 (FLAVOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	2,031.6701	647				
Tasters	1,150.6423	8	143.8303	172.108	2.511	1.938
Treatments	232.7812	71				
Compression	9.4849	2	4.7425	4.946	5.390	3.316
Storage Period	49.0034	3	16.3345	17.036	4.510	2.922
R. H.	34.7997	5	6.9599	7.259	3.699	2.534
R.H. x Storage Period	68.8300	15	4.5887	4.786	2.700	2.015
R.H. x Compression	6.7188	10	0.6719	0.701	2.979	2.165
Storage Period x Compression	35.1818	6	5.8636	6.116	3.474	2.421
R.H. x Storage Period x Compression	28.7626	30	0.9588			
Interaction with Tasters		568				
Tasters x R.H.	60.5614	40	1.5140	1.812	1.592	1.394
Tasters x Storage Period	135.9133	24	5.6631	6.777	1.791	1.517
Tasters x Compression	43.9596	16	2.7475	3.288	2.007	1.647
Tasters x R.H. x Storage Period; Tasters x R.H. x Compression; Tasters x Storage Period x Compression; Tasters x R.H. x Compression x Storage Period	407.8123	488	0.8357			

TABLE 77

CARROT & CABBAGE #7 (ODOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	866.2901	647				
Tasters	306.5957	8	38.3245	86.825	2.511	1.938
Treatments	126.9568	71				
Compression	1.4475	2	0.7238	1.300	5.390	3.316
Storage Period	68.8950	3	22.9650	41.252	4.510	2.922
R. H.	8.6420	5	1.7284	3.105	3.699	2.534
R.H. x Storage Period	10.6050	15	0.7070	1.270	2.700	2.015
R.H. x Compression	6.5339	10	0.6534	1.174	2.979	2.165
Storage Period x Compression	14.1328	6	2.3555	4.231	3.474	2.421
R.H. x Storage Period x Compression	16.7006	30	0.5567			
Interaction with Tasters		568				
Tasters x R.H.	28.8857	40	0.7221	1.636	1.592	1.394
Tasters x Storage Period	154.6883	24	6.4454	14.602	1.791	1.517
Tasters x Compression	33.7469	16	2.1092	4.778	2.007	1.647
Tasters x R.H. x Storage Period Tasters x R.H. x Compression Tasters x Storage Period x Compression Tasters x R.H. x Compression x Storage Period	215.4167	488	0.4414			

TABLE 78

CARROT-CABBAGE #7

EFFECT OF R. H. AND STORAGE PERIOD ON FLAVOR

Storage Period (Mo.)	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Storage Period
0	4.6	4.7	4.5	4.1	5.5	5.3	4.8
2	5.4	5.4	5.2	5.0	5.0	4.5	5.1
3	5.3	5.5	5.0	4.8	4.9	4.4	5.0
4	5.3	6.2	5.8	5.7	5.5	4.7	5.5
Means of R. H.	5.2	5.5	5.1	4.9	5.2	4.8	

Interaction - HSD
Effect of Storage Period - HSD
Effect of R. H. - HSD

TABLE 79

CARROT-CABBAGE #7

EFFECT OF STORAGE PERIOD & COMPRESSION ON FLAVOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	2	3	4	Means of Compression Levels
P_0	5.0	5.6	5.1	5.2	5.3
P_1	4.7	4.9	4.9	5.8	5.1
P_2	4.6	4.6	4.9	5.6	5.0
Means of Storage Period	4.8	5.1	5.0	5.5	

Interaction - HSD
Effect of Compression Level - SD
Effect of Storage Period - HSD

TABLE 80

EFFECT OF STORAGE PERIOD & COMPRESSION ON ODOR

Compression Level	Means of Main Effects Storage Period (Mo.) 0	2	3	4	Means of Compression Levels
P_0	4.8	5.5	5.1	5.4	5.2
P_1	4.8	5.4	5.1	5.8	5.3
P_2	4.7	5.0	5.1	5.9	5.2
Means of Storage Period	4.8	5.3	5.1	5.7	

Interaction - HSD
Effect of Compression Level - NS
Effect of Storage Period - HSD

TABLE 81

STRAWBERRY-APPLE #8 (FLAVOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	5%
Total	1,523.3278	719				
Tasters	974.0778	9	108.2309	325.576	2.407	1.880
Treatments	148.1278	71	2.0863			
Compression	33.0861	2	16.5431	29.115	5.390	3.316
Storage Period	4.6389	3	1.5463	2.721	4.510	2.922
R. H.	43.6611	5	8.7322	15.368	3.699	2.534
R.H. × Storage Period	25.7611	15	1.7174	3.023	2.700	2.015
R.H. × Compression	17.9306	10	1.7931	3.156	2.979	2.165
Storage Period × Compression	6.0028	6	1.0005	1.761	3.474	2.421
R.H. × Storage Period × Compression	17.0472	30	0.5682			
Interaction with Tasters		639				
Tasters × R.H.	35.2556	45	0.7835	1.450	1.562	1.375
Tasters × Storage Period	15.3889	27	0.5700	1.055	1.744	1.488
Tasters × Compression	53.9139	18	2.9952	5.545	1.942	1.609
Tasters × R.H. × Storage Period; Tasters × R.H. × Compression; Tasters × Storage Period × Compression; Tasters × R.H. × Compression × Storage Period	296.5638	549	0.5402			

TABLE 82

STRAWBERRY-APPLE #8 (ODOR)

ANALYSIS OF VARIANCE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance Level 1%	Significance Level 5%
Total	954.8875	719				
Tasters	373.6653	9	41.5184	77.590	2.407	1.880
Treatments	91.5875	71	1.2900			
Compression	9.7583	2	4.8792	10.738	5.390	3.316
Storage Period	6.5264	3	2.1755	4.788	4.510	2.922
R. H.	21.9625	5	4.3925	9.667	3.699	2.534
R.H. x Storage Period	11.4986	15	0.7666	1.687	2.700	2.015
R.H. x Compression	25.9917	10	2.5992	5.720	2.979	2.165
Storage Period x Compression	2.2195	6	0.3699	0.814	3.474	2.421
R.H. x Storage Period x Compression	13.6305	30	0.4544			
Interaction with Tasters		639				
Tasters x R.H.	75.0930	45	1.6687	3.119	1.562	1.375
Tasters x Storage Period	36.9736	27	1.3694	2.559	1.744	1.488
Tasters x Compression	83.7972	18	4.6554	8.700	1.942	1.609
Tasters x R.H. x Storage Period Tasters x R.H. x Compression Tasters x Storage Period x Compression Tasters x R.H. x Compression x Storage Period	293.7709	549	0.5351			

TABLE 83

STRAWBERRY-APPLE DISCS

EFFECT OF COMPRESSION AND RELATIVE HUMIDITY ON FLAVOR

Compression Level	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Compression Level
P_0	7.2	7.2	7.0	6.8	6.6	6.2	6.8
P_1	6.0	6.7	6.6	6.4	6.4	5.9	6.3
P_2	6.5	6.5	6.5	6.8	6.4	6.0	6.4
Means of R. H.	6.6	6.8	6.7	6.6	6.5	6.2	

Interaction - HSD
Effect of Compression - HSD
Effect of R. H. - HSD

TABLE 84

EFFECT OF COMPRESSION AND RELATIVE HUMIDITY ON ODOR

Compression Level	Means of Main Effects Relative Humidity(%) 0	3.0	7.0	11.1	20.4	31.9	Means of Compression Level
P_0	6.9	6.9	6.8	6.3	6.4	6.1	6.6
P_1	6.0	6.5	6.4	6.4	6.6	6.2	6.3
P_2	6.4	6.1	6.7	6.2	6.4	5.9	6.3
Means of R. H.	6.4	6.5	6.6	6.3	6.5	6.1	

Interaction - HSD
Effect of Compression - HSD
Effect of R. H. - HSD

TABLE 85

REHYDRATION CHARACTERISTICS OF COMPRESSED BEEF-SPINACH #1 (75:25) AFTER STORAGE AT VARIOUS HUMIDITIES AT 100° F.

Relative Humidity	Weight (grams) of 0.5 × 2" diam.	Compression psi/sec.	Time (minutes) for complete apparent rehydration after storage			
			0 Months	1 Month	2 Months	3 Months
No Storage	18	330/30	0.5	-	-	-
	20	1100/30	1	-	-	-
0	18	330/30	-	2	3	3
	20	1100/30	-	4	5	4
3.0	18	330/30	-	1.5	1.5	2
	20	1100/30	-	3	3	3
7.0	18	330/30	-	2	2	2
	20	1100/30	-	3	4	3
11.1	18	330/30	-	5	7	6
	20	1100/30	-	12	16	14
20.4	18	330/30	-	6	7	6.5
	20	1100/30	-	15	18	17
31.9	18	330/30	-	8	9	9
	20	1100/30	-	27	29	30

TABLE 86

REHYDRATION CHARACTERISTICS OF COMPRESSED BEEF-EGGS (50:50) BARS
AFTER STORAGE AT VARIOUS HUMIDITIES AT 100° F.
(Combination #2)

Relative Humidity	Weight (grams) of 0.5" x 2" diam.	Compression psi/sec.	Time (minutes) for complete apparent rehydration after storage			
			0 Months	1/2 Mo.	1 Month	3 Months
No Storage	20	500/30	0.5	-	-	-
	22	1000/30	0.5	-	-	-
0	20	500/30	-	0.5	0.5	-
	22	1000/30	-	0.5	0.5	-
3	20	500/30	-	0.5	0.5	-
	22	1000/30	-	0.5	0.5	-
7	20	500/30	-	0.5	0.5	-
	22	1000/30	-	0.5	0.5	-
11.1	20	500/30	-	0.5	0.5	-
	22	1000/30	-	0.5	0.5	-
20.4	20	500/30	-	0.5	0.5	-
	22	1000/30	-	0.5	0.5	-
31.9	20	500/30	-	0.5	0.5	-
	22	1000/30	-	0.5	0.5	-

TABLE 87

Combination #3

REHYDRATION CHARACTERISTICS OF COMPRESSED BEEF-SPINACH (39:61) BARS
AFTER STORAGE AT VARIOUS HUMIDITIES AT 100° F.

Relative Humidity	Weight (grams) of 0.5" x 2" diam.	Compression psi/sec.	Time (minutes) for complete apparent rehydration after storage			
			0 Months	1 Month	2 Months	3 Months
No Storage	12	330/30	0.5	-	-	-
	18	1100/30	0.5	-	-	-
0	12	330/30	-	2	2.5	3
	18	1100/30	-	3	3	3
3	12	330/30	-	2	1.5	2
	18	1100/30	-	3	5	4
7	12	330/30	-	2	4	4
	18	1100/30	-	6	5	6
11.1	12	330/30	-	5.5	6	6
	18	1100/30	-	7	7	7
20.4	12	330/30	-	8	9	9
	18	1100/30	-	8.5	9	9
31.9	12	330/30	-	10	10	11
	18	1100/30	-	12	11.5	12

TABLE 88

Combination #4
REHYDRATION CHARACTERISTICS OF COMPRESSED SPINACH-EGGS (25:75) BARS
AFTER STORAGE AT VARIOUS HUMIDITIES AT 100° F.

Relative Humidity	Weight (grams) of 0.5" × 2" diam.	Compression psi/sec.	Time (minutes) for complete apparent rehydration after storage			
			0 Months	1 Month	2 Months	3 Months
No Storage	14	500/30	1.5	-	-	-
	17	1000/30	8	-	-	-
0	14	500/30	-	4	-	-
	17	1000/30	-	55	-	-
3	14	500/30	-	4	-	-
	17	1000/30	-	52	-	-
7	14	500/30	-	4	-	-
	17	1000/30	-	57	-	-
11.1	14	500/30	-	5	-	-
	17	1000/30	-	58	-	-
20.4	14	500/30	-	4	-	-
	17	1000/30	-	50	-	-
31.9	14	500/30	-	4.5	-	-
	17	1000/30	-	55	-	-

TABLE 89

Combination #5
REHYDRATION CHARACTERISTICS OF COMPRESSED BEEF-POTATOES (55:45) BARS
AFTER STORAGE AT VARIOUS HUMIDITIES AT 100° F.

Relative Humidity	Weight (grams) of 0.5" x 2" diam.	Compression psi/sec.	Time (minutes) for complete apparent rehydration after storage			
			0 Months	1 Month	2 Months	3 Months
No Storage	25	2000/30 sec.	0.5	--	--	--
	30	4000/30 sec.	0.5	--	--	--
0	25	2000/30 sec.	--	0.5	0.5	
	30	4000/30 sec.		0.5	0.5	
3	25	2000/30 sec.	--	0.5	0.5	
	30	4000/30 sec.	--	0.5	0.5	
7	25	2000/30 sec.	--	0.5	0.5	
	30	4000/30 sec.	--	1	1	
11.1	25	2000/30 sec.	--	0.5	1	
	30	4000/30 sec.	--	1	1	
20.4	25	2000/30 sec.	--	0.5	0.5	
	30	4000/30 sec.	--	1	1	
31.9	25	2000/30 sec.	--	1	1	
	30	4000/30 sec.	--	1.5	2	

TABLE 90

Combination #6
REHYDRATION CHARACTERISTICS OF COMPRESSED CABBAGE-CARROTS (82:18)
BARS AFTER STORAGE AT VARIOUS HUMIDITIES AT 100° F.

Relative Humidity	Weight (grams) of 0.5 x 2" diam.	Compression psi/sec.	Time (minutes for complete apparent rehydration after storage			
			0 Months	2 Months	3 Months	4 Months
No Storage	14	300/30 sec.	0.5	--	--	--
	17	500/30 sec.	1.5	--	--	--
0	14	300/30 sec.	--	3	3	3
	17	500/30 sec.	--	10	10	8
3	14	300/30 sec.	--	3	3	3
	17	500/30 sec.	--	3	3	3
7	14	300/30 sec.	--	3	3	3
	17	500/30 sec.	--	3	3	3
11.1	14	300/30 sec.	--	3	3	3
	17	500/30 sec.	--	5	6.5	6
20.4	14	300/30 sec.	--	3	3	3
	17	500/30 sec.	--	6	6	7
31.9	14	300/30 sec.	--	3	3	3
	17	500/30 sec.	--	3	3	3

TABLE 91

Combination #7
REHYDRATION CHARACTERISTICS OF COMPRESSED CABBAGE-CARROTS (64:36) BARS AFTER STORAGE AT VARIOUS HUMIDITIES AT 100° F.

Relative Humidity	Weight (grams) of 0.5 x 2" diam.	Compression psi/sec.	Time (minutes) for complete apparent rehydration after storage			
			0 Months	2 Months	3 Months	4 Months
No Storage	12	300/30 sec.	1.5	--	--	--
	13	500/30 sec.	2	--	--	--
0	12	300/30 sec.	--	3.5	3.5	4
	13	500/30 sec.	--	7	6.5	6.5
3	12	300/30 sec.	--	6.5	6.5	6.5
	13	500/30 sec.	--	12	13	15
7	12	300/30 sec.	--	5	5	6
	13	500/30 sec.	--	10	6.5	18
11.1	12	300/30 sec.	--	5	5	5
	13	500/30 sec.		10	6.5	12
20.4	12	300/30 sec.	--	4	5	5
	13	500/30 sec.		6	6.5	6
31.4	12	300/30 sec.	--	5.5	5.5	5
	13	500/30 sec.	--	6.5	7	7

TABLE 92

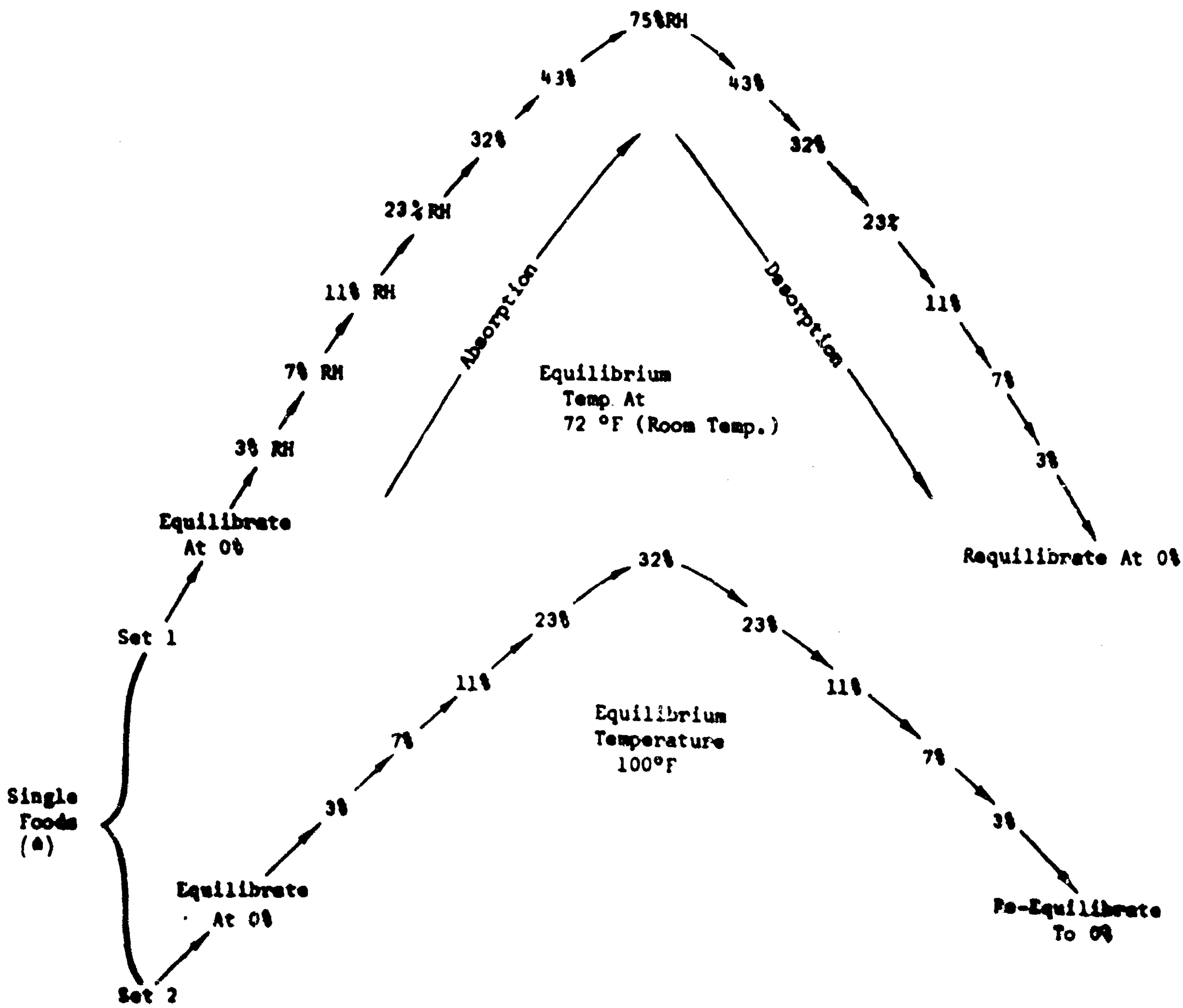
Combination #8

REHYDRATION CHARACTERISTICS OF COMPRESSED APPLES-STRAWBERRIES BARS (50:50) AFTER STORAGE AT VARIOUS HUMIDITIES AT 100°F.

Relative Humidity	Weight (grams) of 0.5 x 2" diam.	Compression psi/sec.	Time (minutes) for complete apparent rehydration after storage			
			0 Months	1 Month	2 Months	3 Months
No Storage	10	200/30	60	-	-	-
	12	300/30	200	-	-	-
0	10	200/30	-	90	120	60
	12	300/30	-	160	160	200
3.0	10	200/30	-	90	90	60
	12	300/30	-	160	180	200
7.0	10	200/30	-	90	120	60
	12	300/30	-	160	200	125
11.1	10	200/30	-	180	180	60
	12	300/30	-	200	200	200
20.4	10	200/30	-	90	120	90
	12	300/30	-	200	200	200
31.9	10	200/30	-	120	120	90
	12	300/30	-	200	120	200

HYSTERESIS STUDIES FIGURE 1

PART I - COMPRESSED SINGLE FOODS



Each Food Set Comprised of 3 Compressed and 3 Uncompressed Samples

*Single Foods
1. Beef (2500psi/30 sec.)
2. Eggs (700 psi/30 sec.)
3. Spinach (3300 psi/30 sec.)
4. Cabbage (1000 psi/30 sec.)
5. Carrots (300 psi/30 sec.)
6. Apples (300 psi/30 sec.)
7. Strawberries (300 psi/30 sec.)

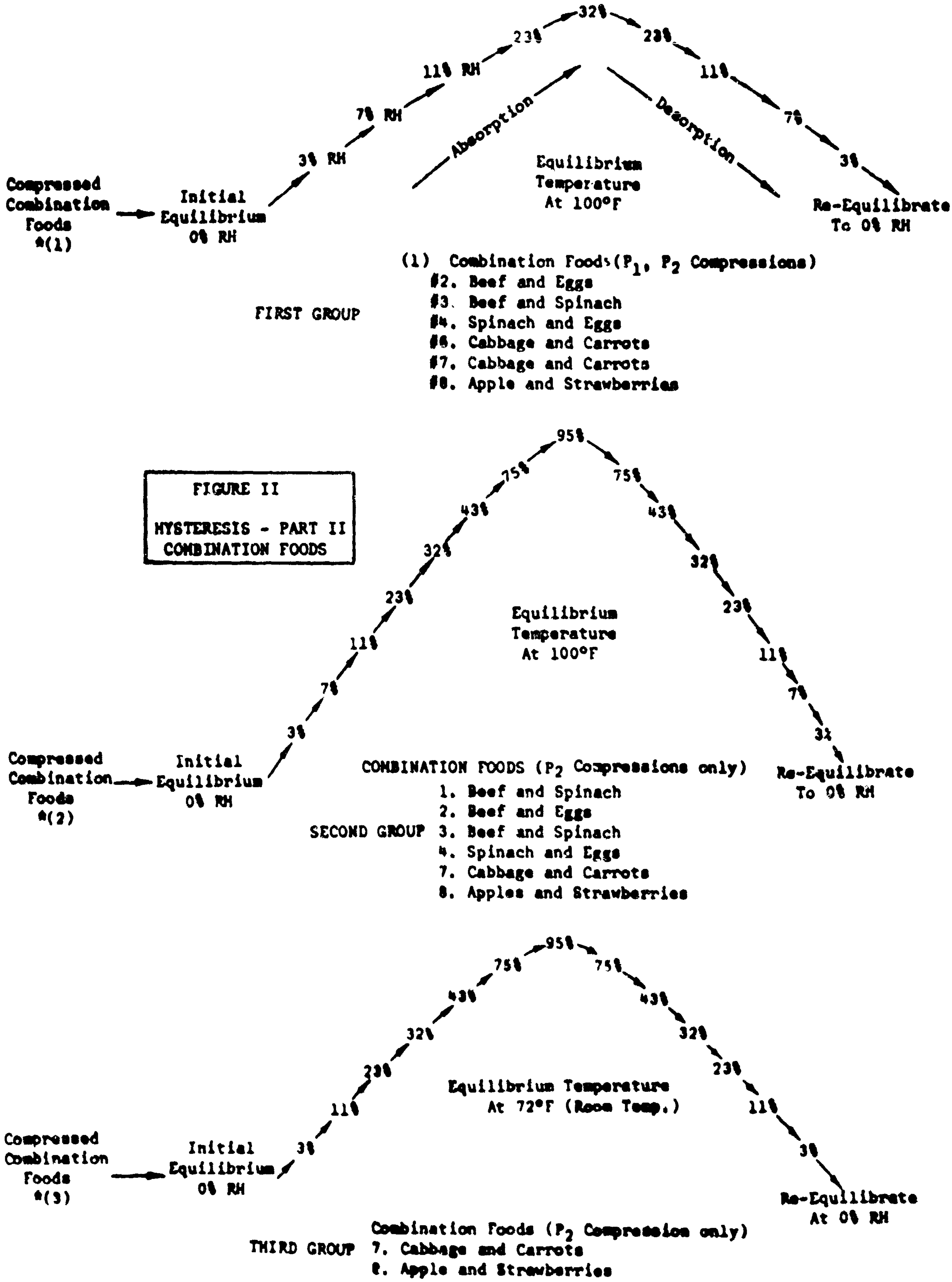


FIGURE II

HYSTERESIS - PART II
COMBINATION FOODS

FIGURE III

HYSTERESIS - THIRD PART

TWO FOOD COMBINATION (P_2 Level only)

\# 7. Cabbage and Carrots 500 psi/30 sec
\# 8. Apple and Strawberries 300 psi/30 sec

3 Initial Equilibrium Levels (3, 11, 23% RH) All Equilibrated At 100°F

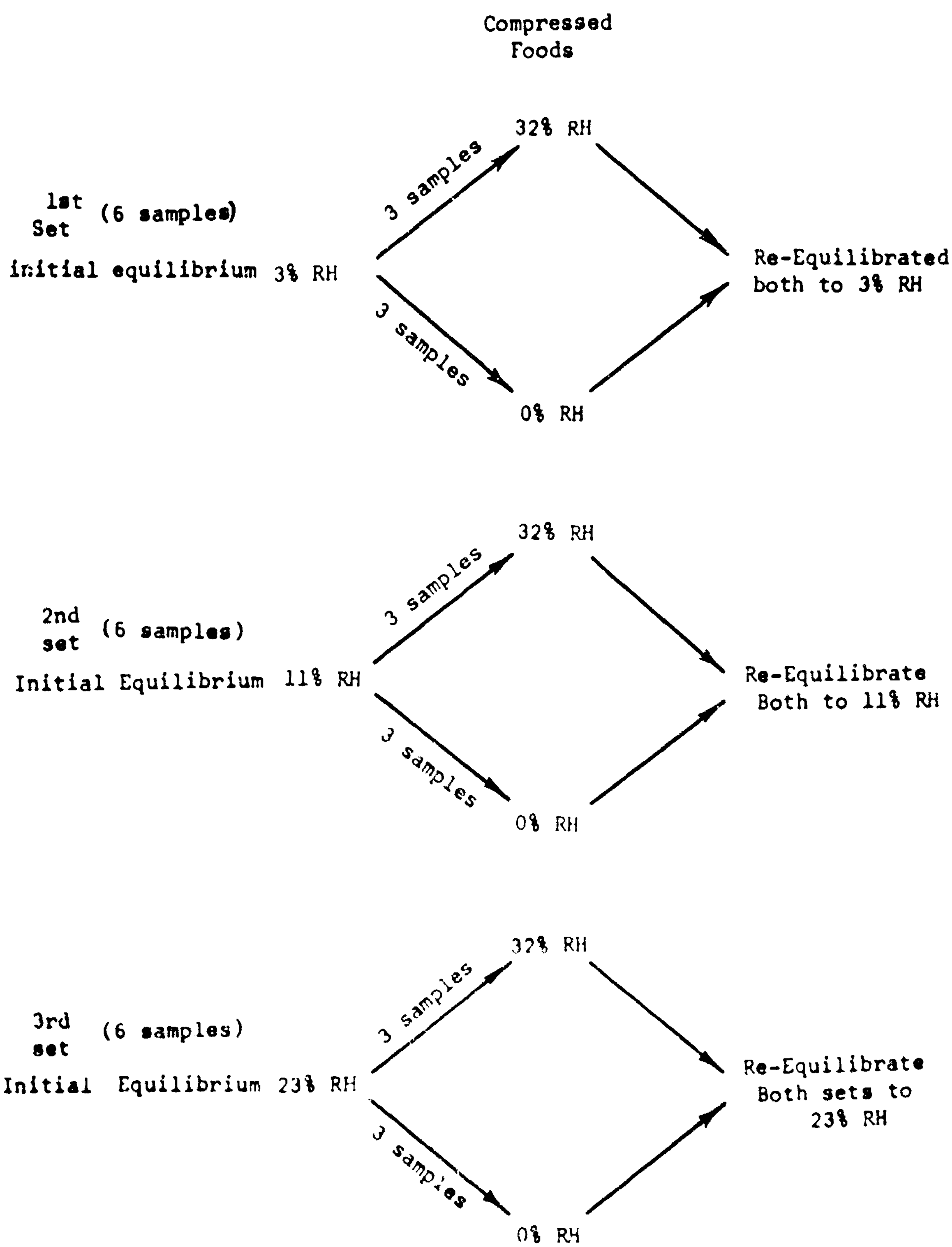


FIGURE 4 Jar Assembly and Components

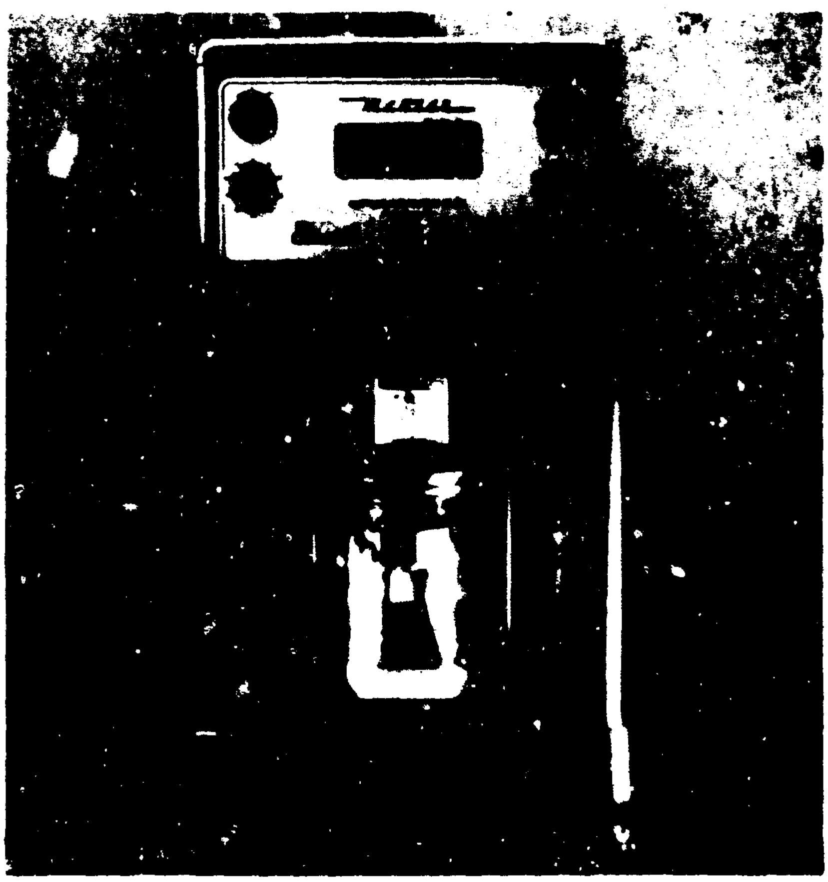


FIGURE 5 Jar Assembly Placement in Mettler Balance for Direct Weighing Procedure

FIGURE 6 Die Used for Compressing Foods into Aluminum Holder

FIGURE 7 Jars Used for Bulk Storage of Samples Used for Stability Analysis

FIGURE 8 Taste Panel Room Used for Organoleptic Analysis

FIGURE IX

SAMPLE BALLOT

Sample No.____________________

Name______________________________

Please check your opinion of each sample:

	Flavor	Odor
Like extremely		
Like very much		
Like moderately		
Like slightly		
Neither like nor dislike		
Dislike slightly		
Dislike moderately		
Dislike very much		
Dislike extremely		

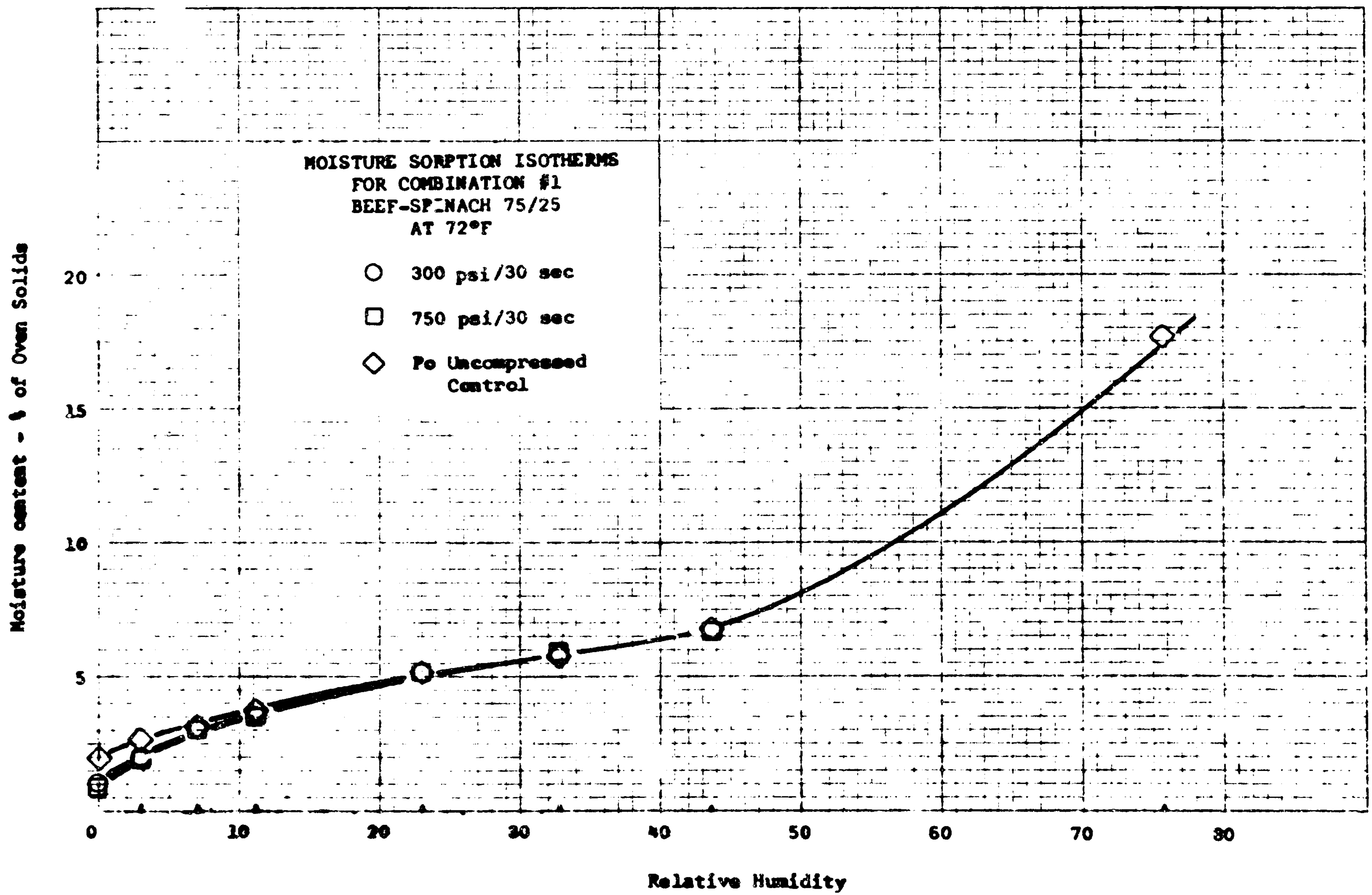

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #1
BEEF-SPINACH 75/25
AT 72°F
300 psi/30 sec
750 psi/30 sec
Po Uncompressed Control
Moisture content - % of Oven Solids
20
15
10
5
0
10
20
30
40
50
60
70
80
Relative Humidity

FIGURE X

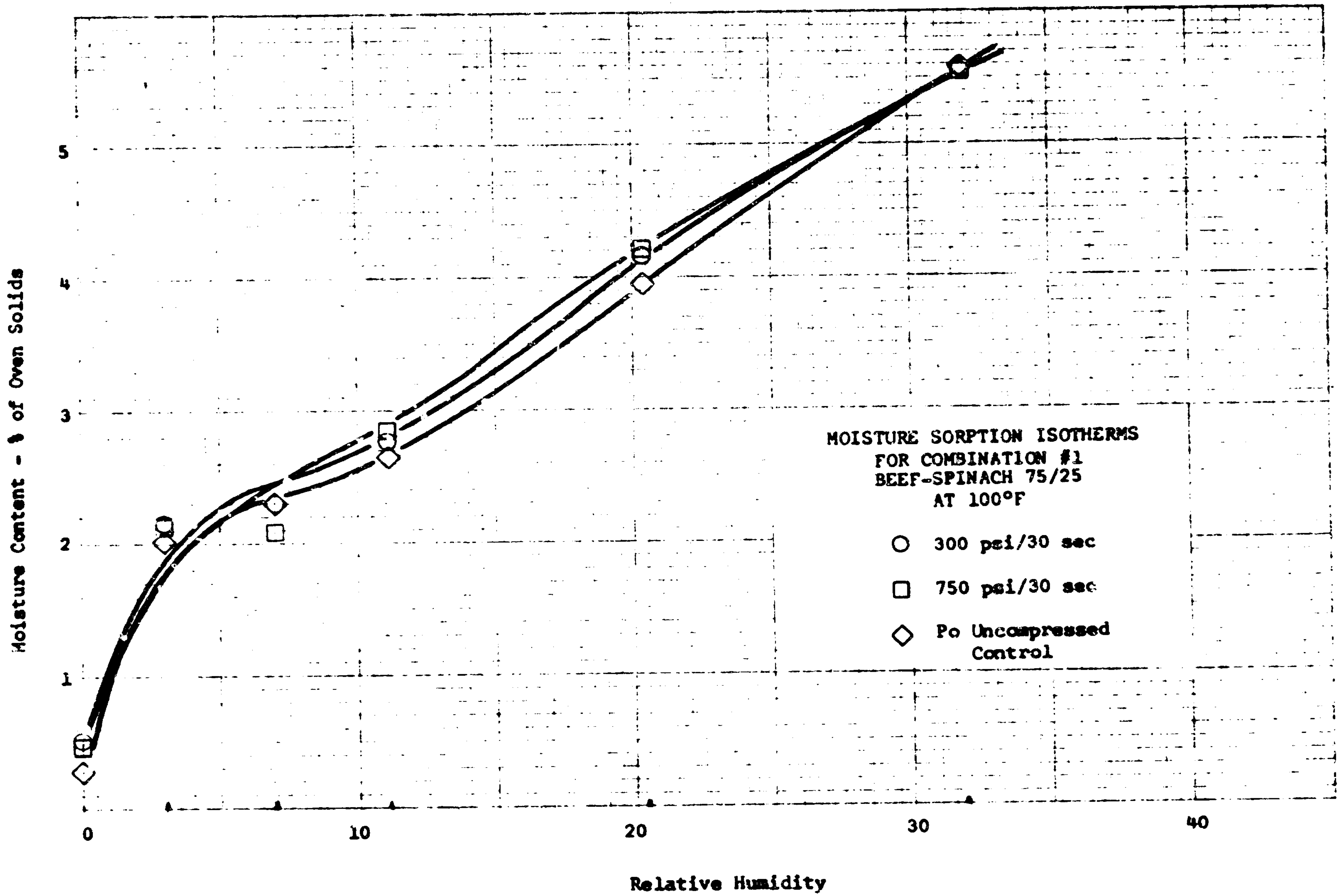
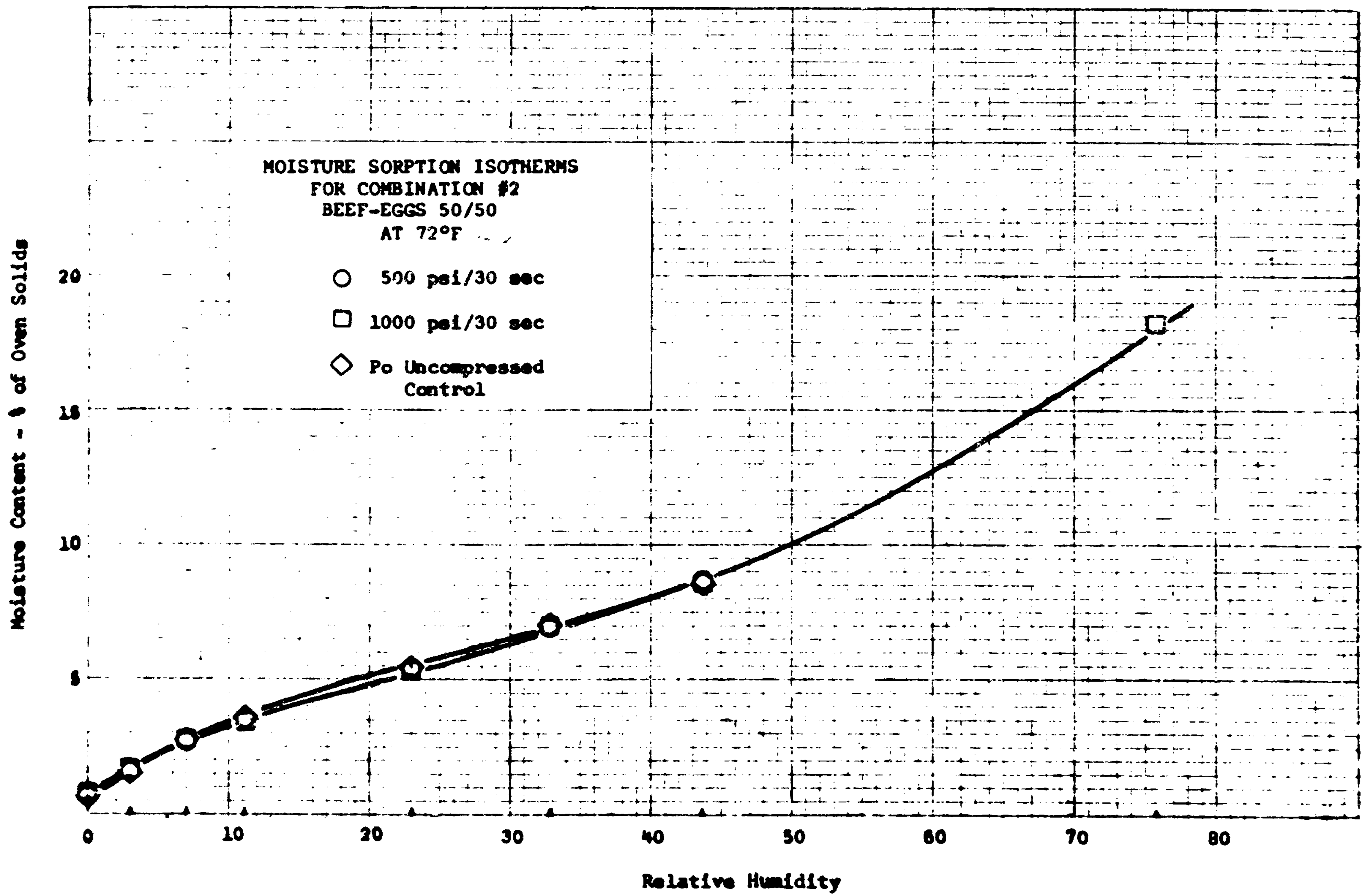

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #1
BEEF-SPINACH 75/25
AT 100°F
300 psi/30 sec
750 psi/30 sec
Po Uncompressed Control
Moisture Content - % of Oven Solids
1
2
3
4
5
0
10
20
30
40
Relative Humidity

FIGURE XI



MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #2
BEEF-EGGS 50/50
AT 72°F
500 psi/30 sec
1000 psi/30 sec
Po Uncompressed Control
Moisture Content - % of Oven Solids
20
15
10
5
0
10
20
30
40
50
60
70
80
Relative Humidity

FIGURE XII

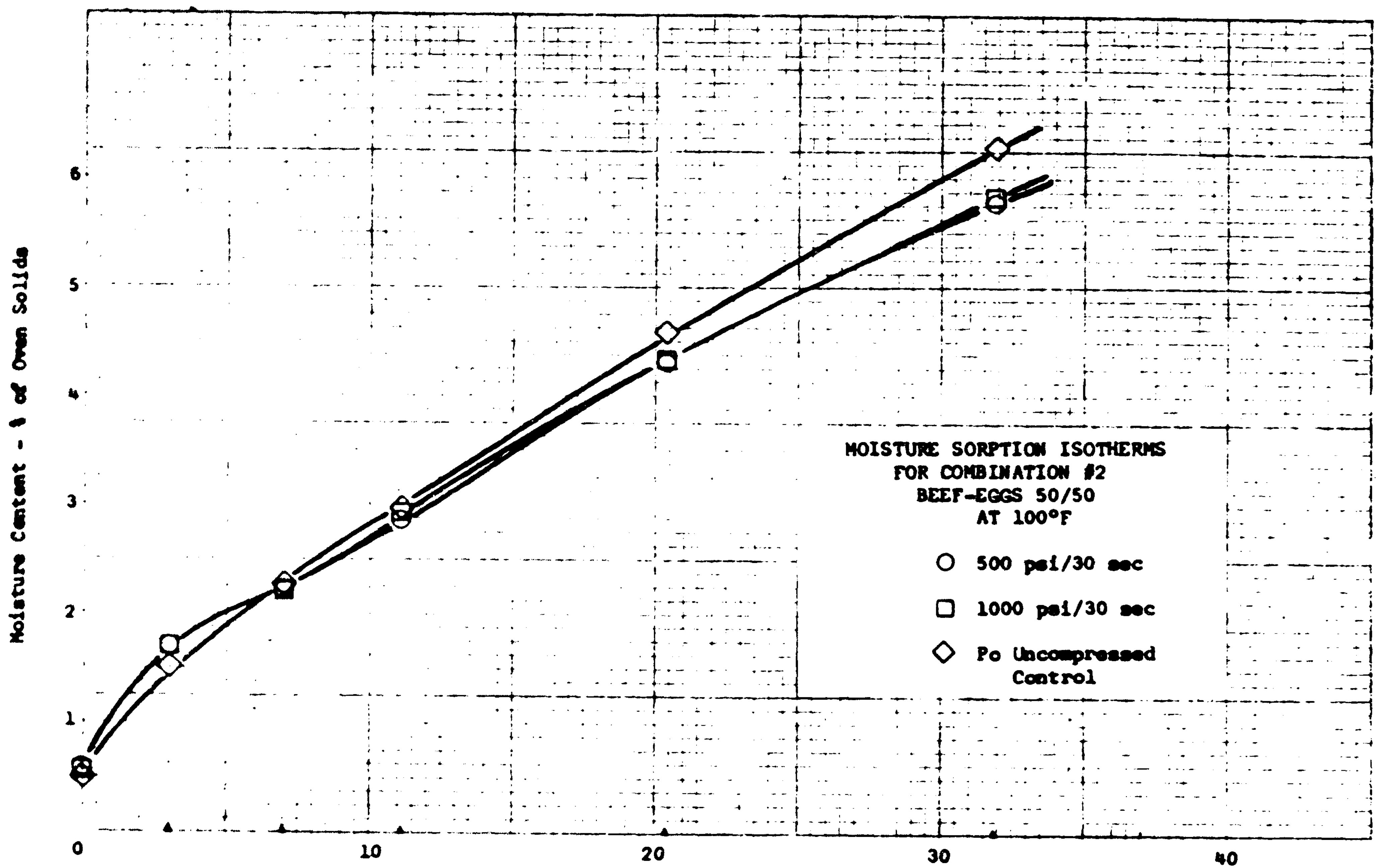

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #2
BEEF-EGGS 50/50
AT 100°F
500 psi/30 sec
1000 psi/30 sec
Po Uncompressed Control
Moisture Content - % of Oven Solids
Relative Humidity
0
10
20
30
40
1
2
3
4
5
6

FIGURE XIII

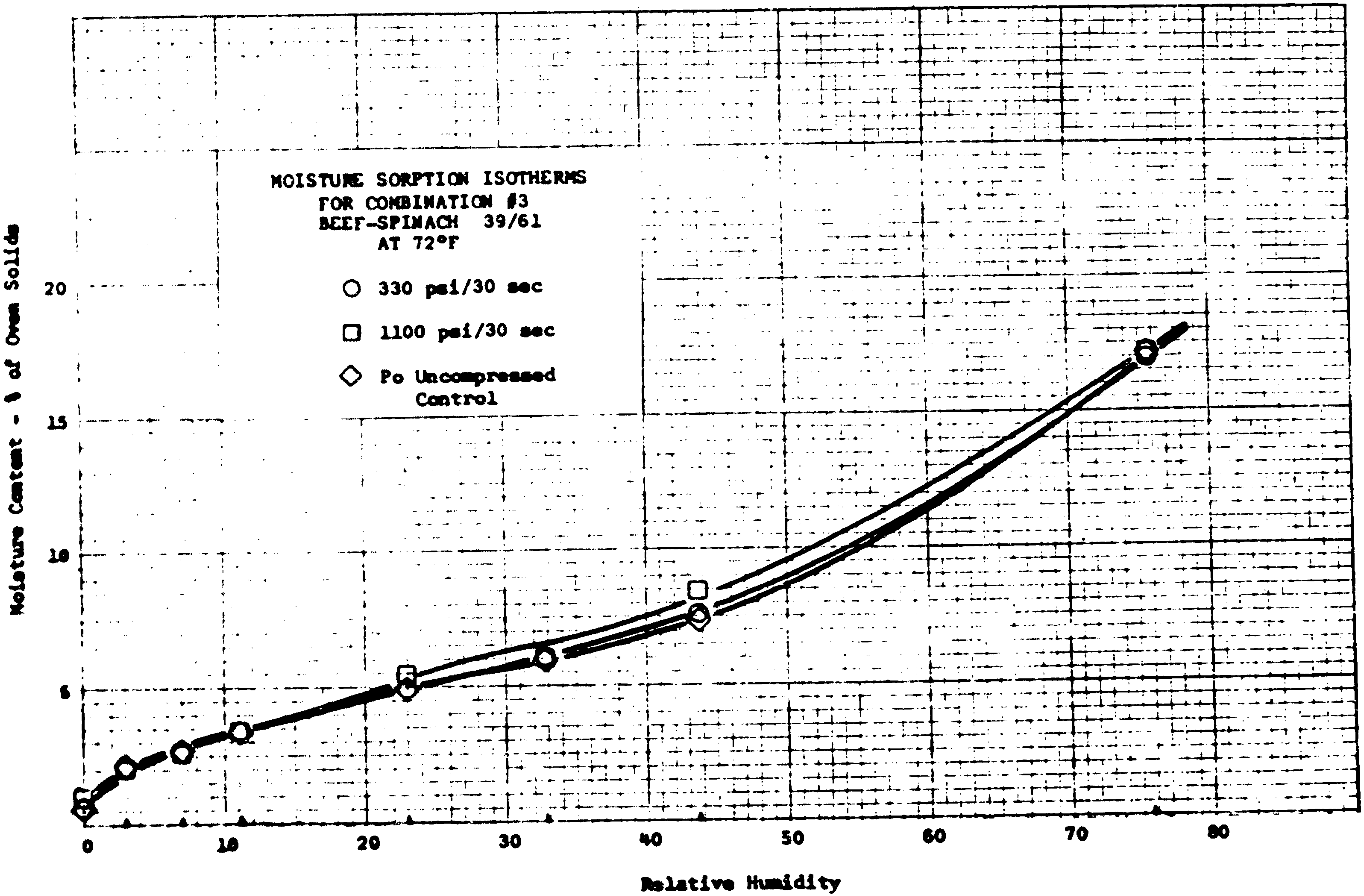

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #3
BEEF-SPINACH 39/61
AT 72°F
330 psi/30 sec
1100 psi/30 sec
Po Uncompressed Control
Moisture Content - % of Oven Solids
20
15
10
5
0
10
20
30
40
50
60
70
80
Relative Humidity

FIGURE XIV

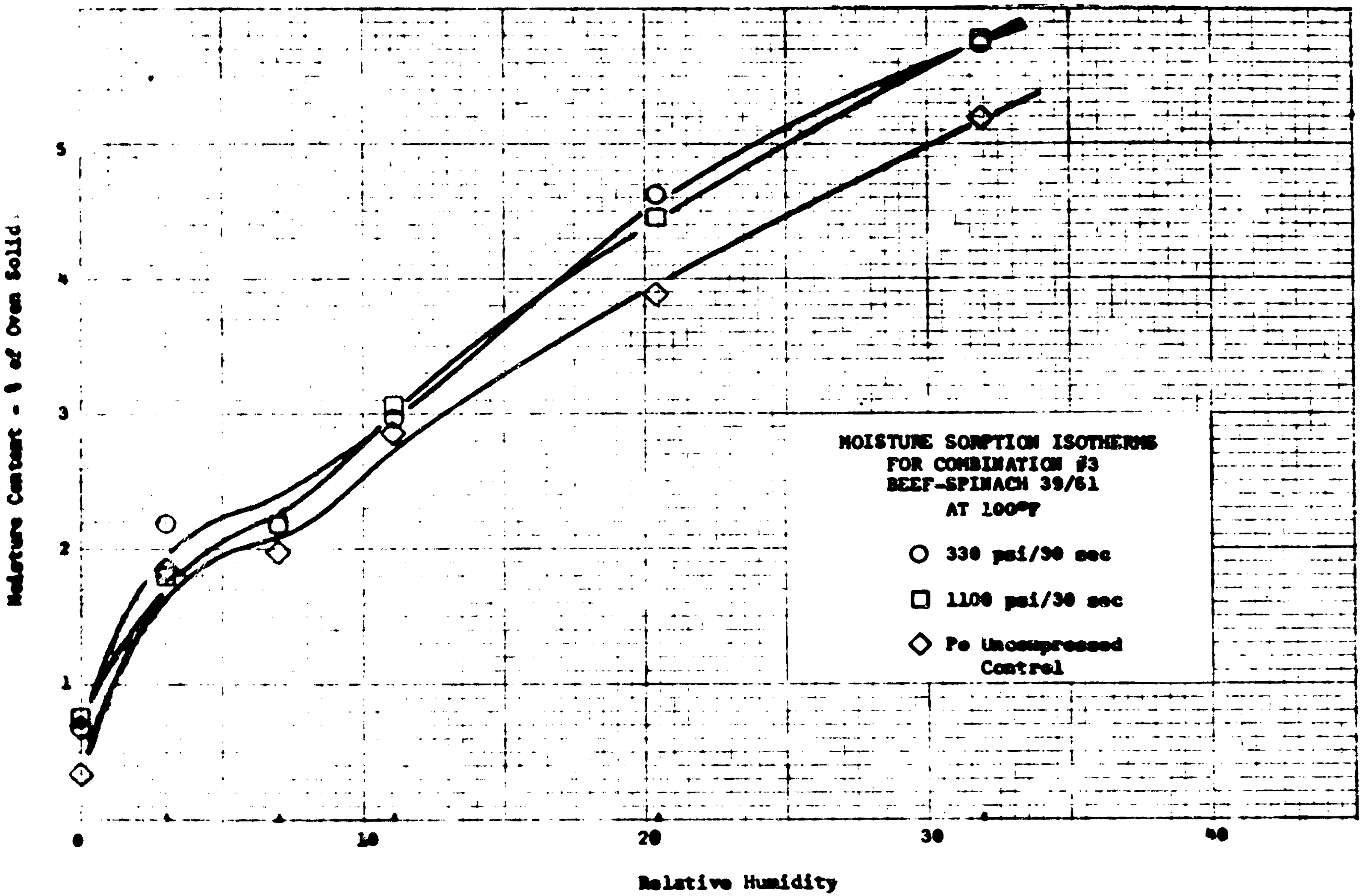

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #3
BEEF-SPINACH 39/61
AT 100°F
330 psi/30 sec
1100 psi/30 sec
Pe Uncompressed Control
Moisture Content - % of Oven Solid
Relative Humidity
0
10
20
30
40
1
2
3
4
5

FIGURE XV

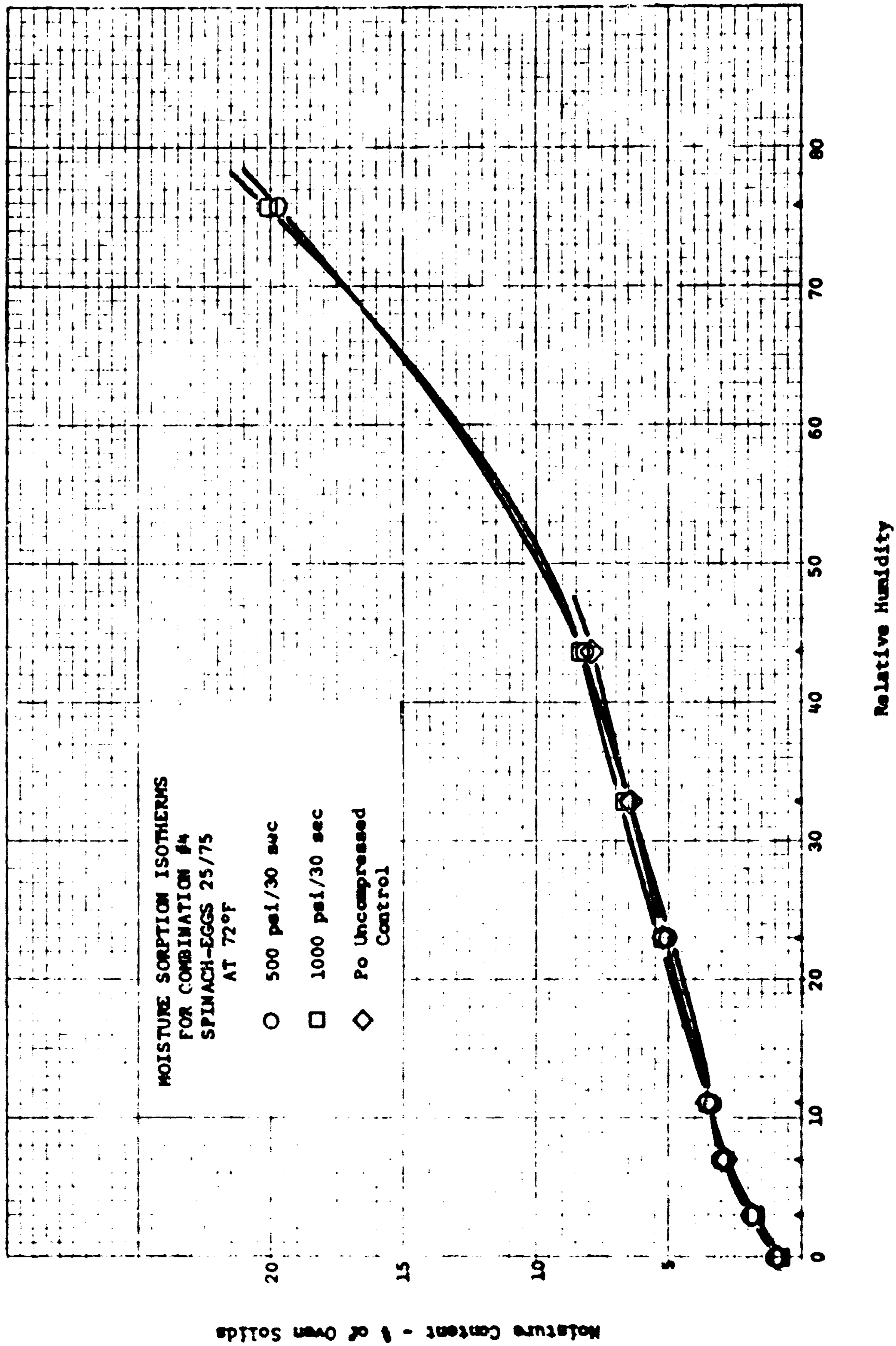

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #4
SPINACH-EGGS 25/75
AT 72°F
500 psi/30 sec
1000 psi/30 sec
Po Uncompressed Control
Relative Humidity
Moisture Content - % of Oven Solids
0
10
20
30
40
50
60
70
80
5
10
15
20

FIGURE XVI

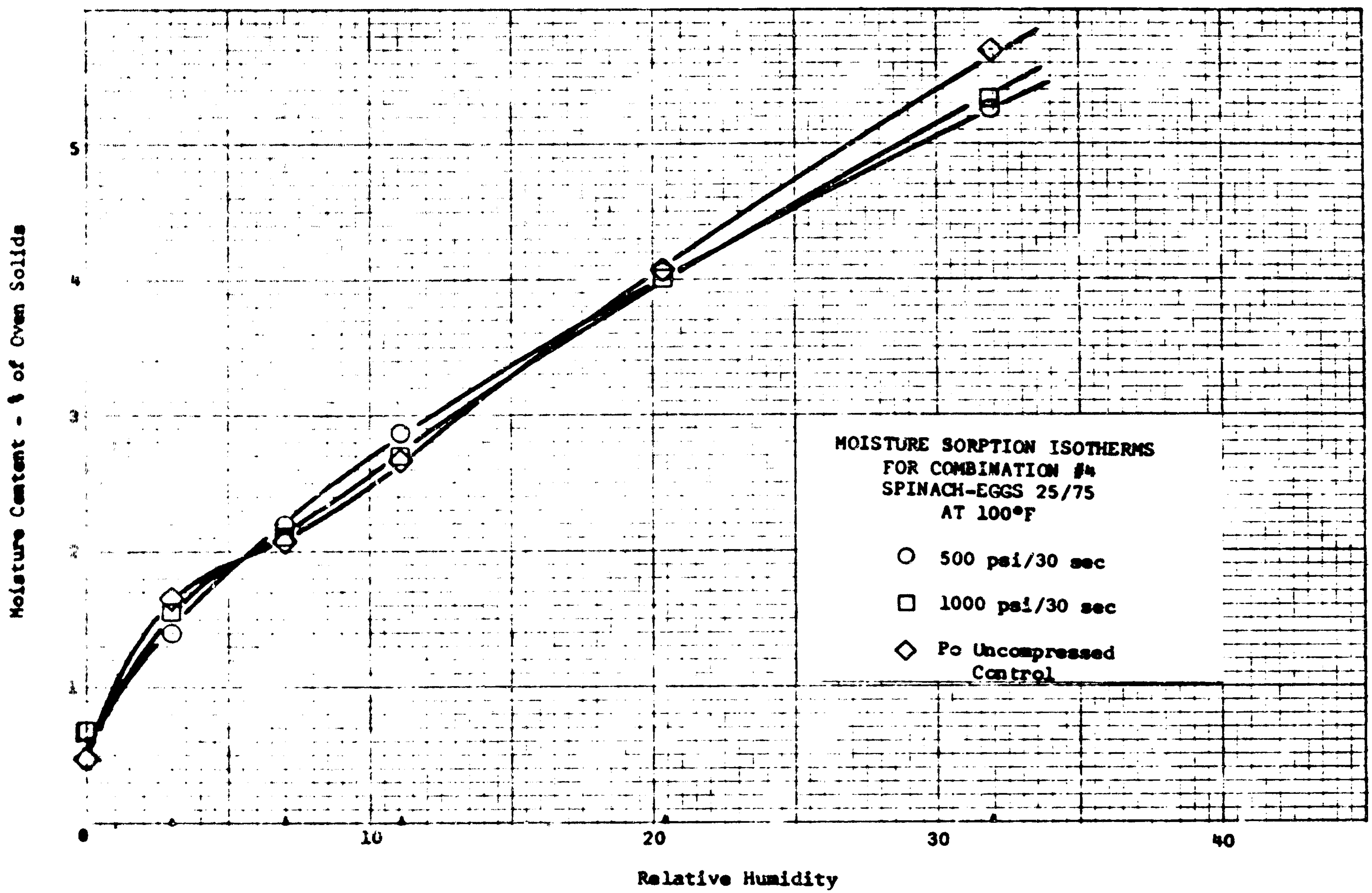

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #4
SPINACH-EGGS 25/75
AT 100°F
500 psi/30 sec
1000 psi/30 sec
Po Uncompressed Control
Moisture Content - % of Oven Solids
1
2
3
4
5
0
10
20
30
40
Relative Humidity

FIGURE XVII

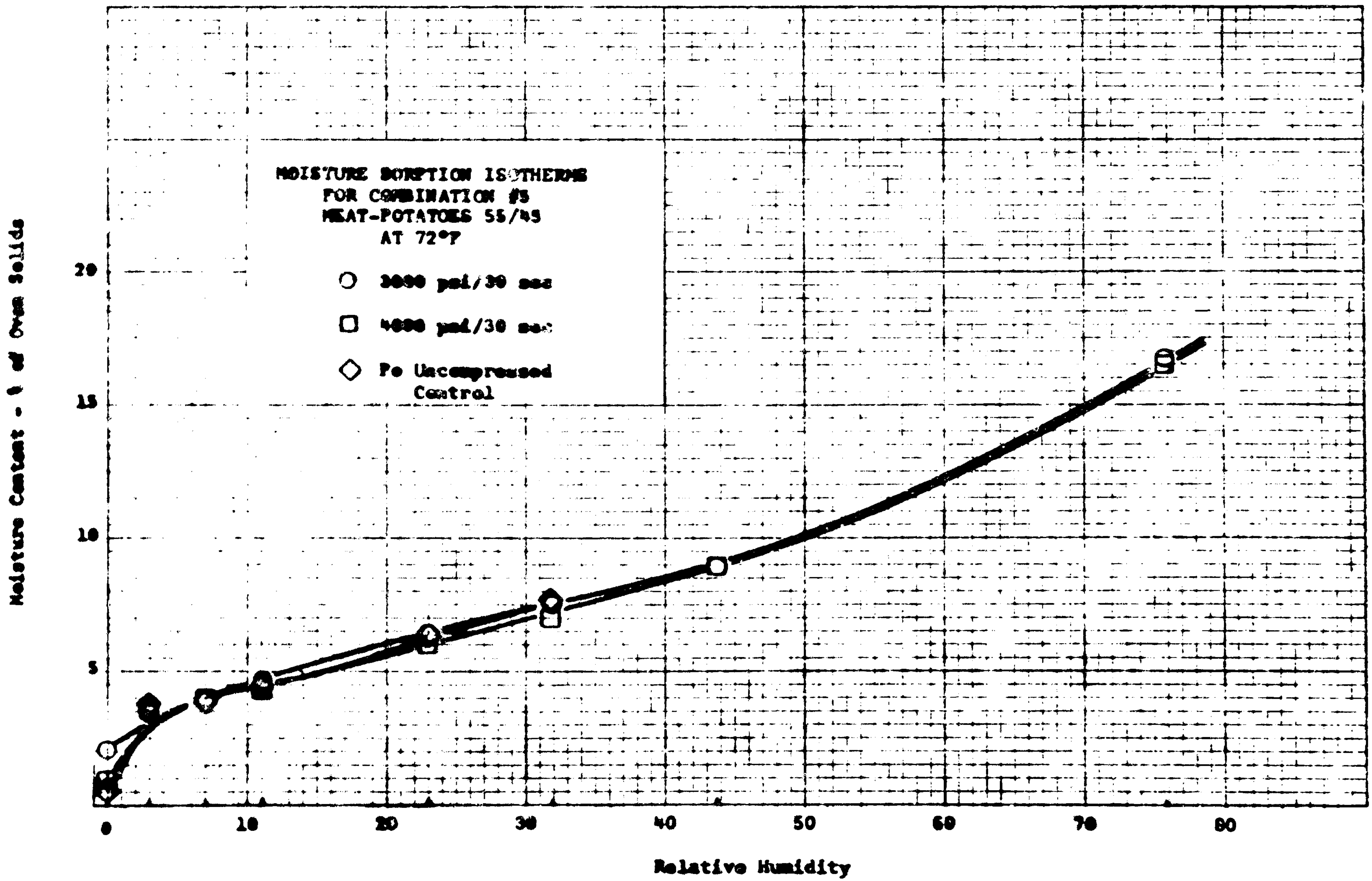


FIGURE XVIII

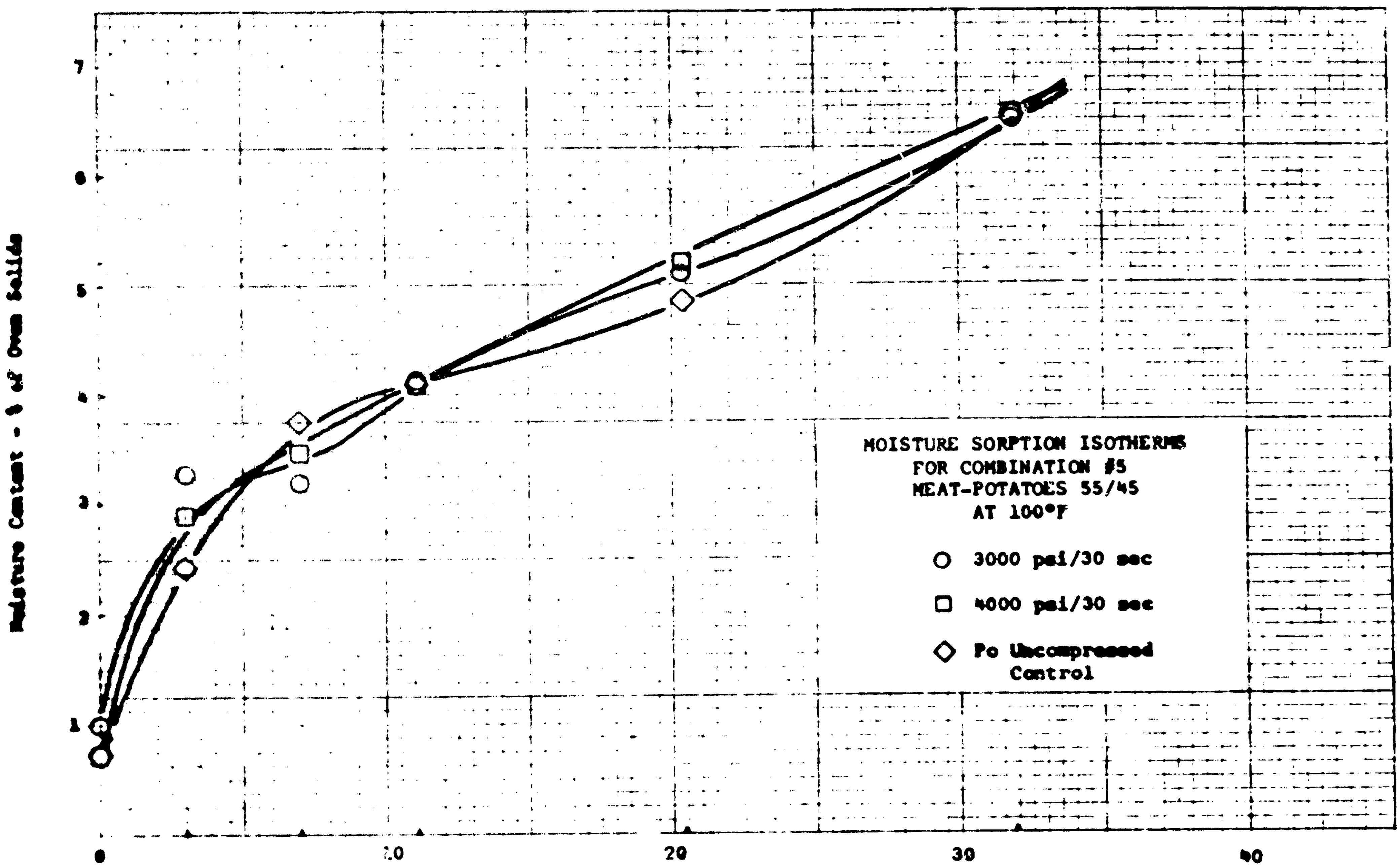

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #5
MEAT-POTATOES 55/45
AT 100°F
3000 psi/30 sec
4000 psi/30 sec
Po Uncompressed Control
Moisture Content - % of Oven Solids
Relative Humidity
0
10
20
30
40
1
2
3
4
5
6
7

FIGURE XIX

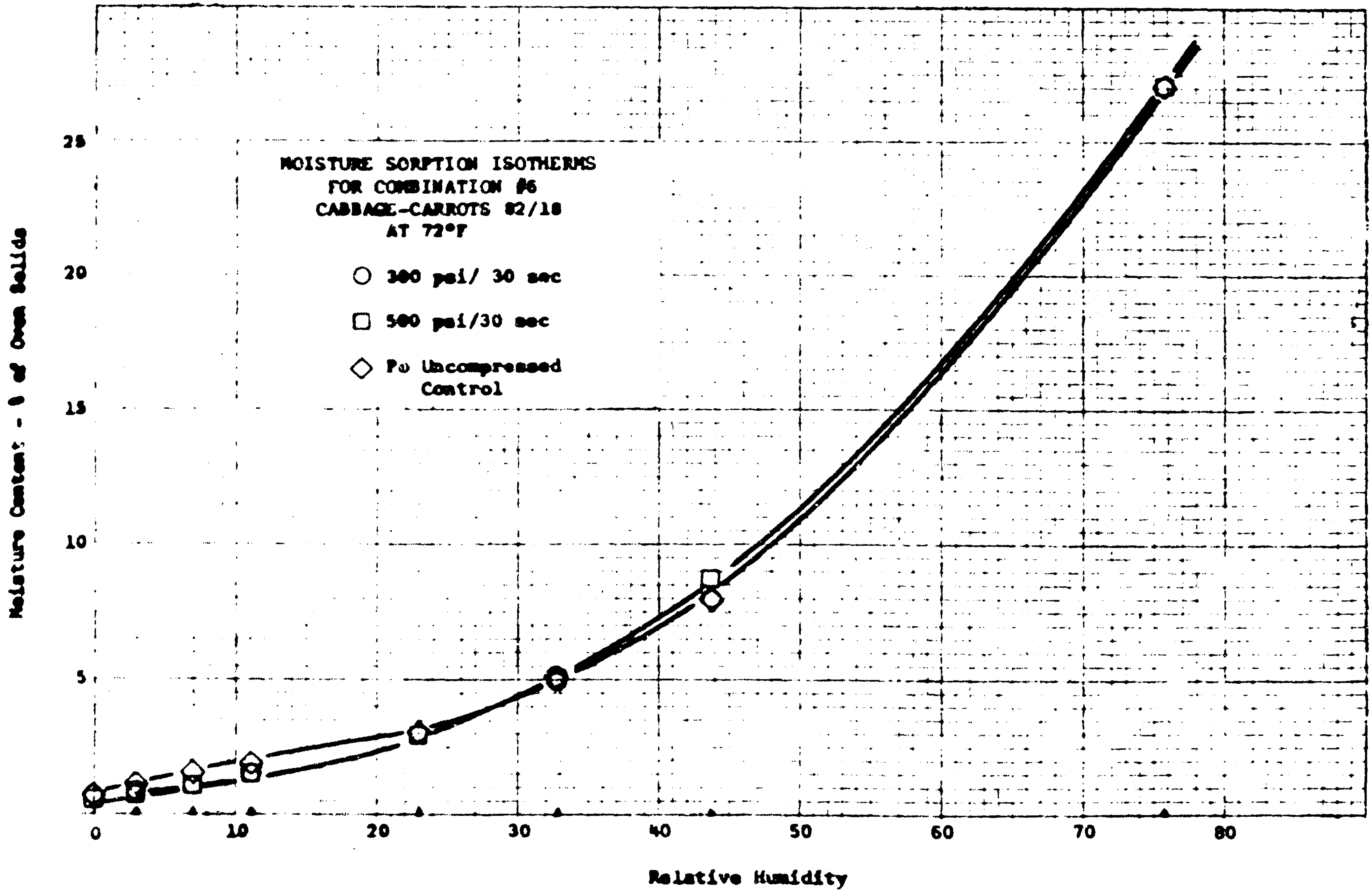

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #6
CABBAGE-CARROTS 82/18
AT 72°F
300 psi/ 30 sec
500 psi/30 sec
Po Uncompressed
Control
Moisture Content - % of Oven Solids
25
20
15
10
5
0
10
20
30
40
50
60
70
80
Relative Humidity

FIGURE XX

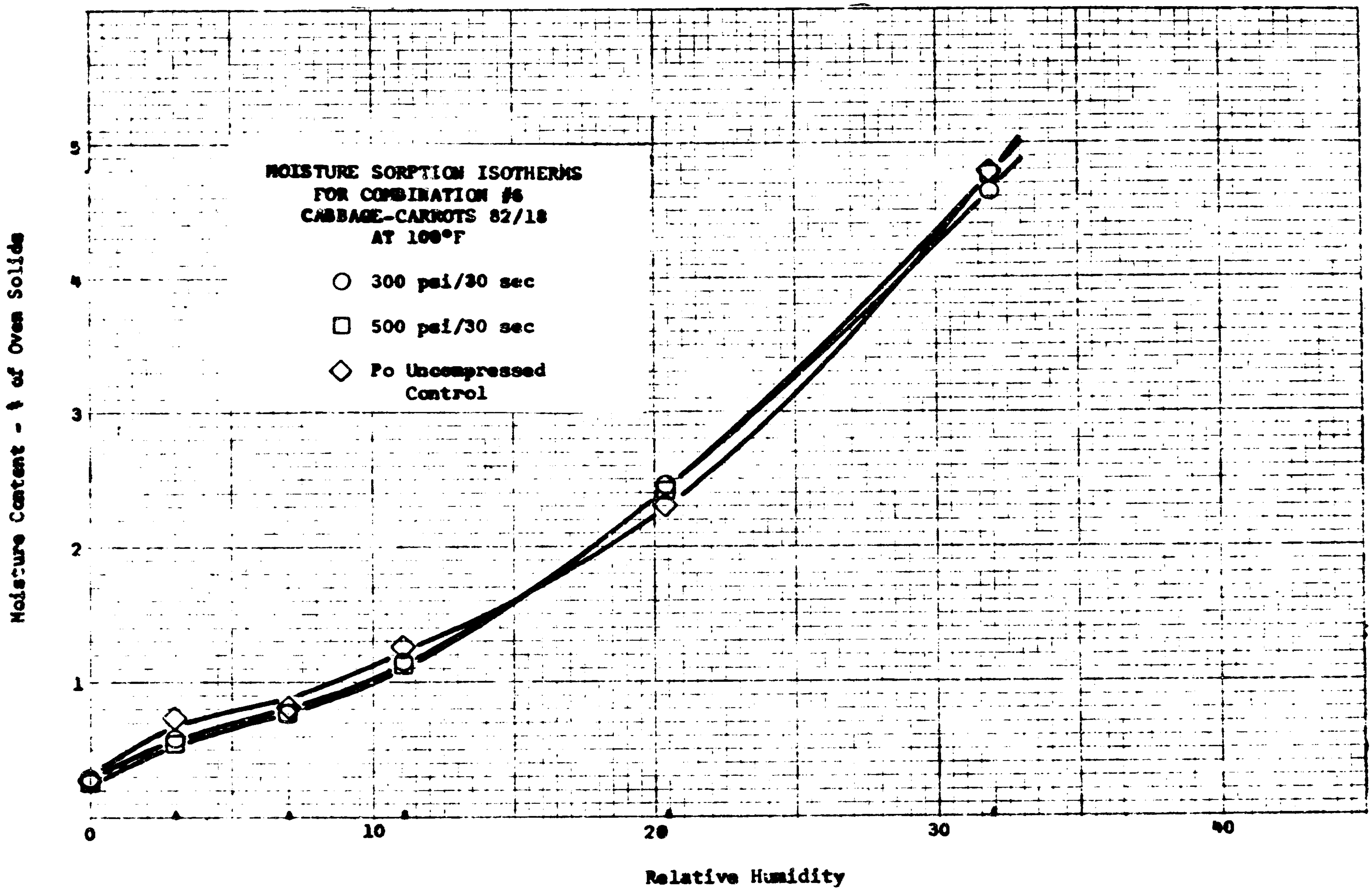

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #6
CABBAGE-CARROTS 82/18
AT 100°F
300 psi/30 sec
500 psi/30 sec
Po Uncompressed
Control
Moisture Content - % of Oven Solids
Relative Humidity
0
10
20
30
40
1
2
3
4
5

FIGURE XXI

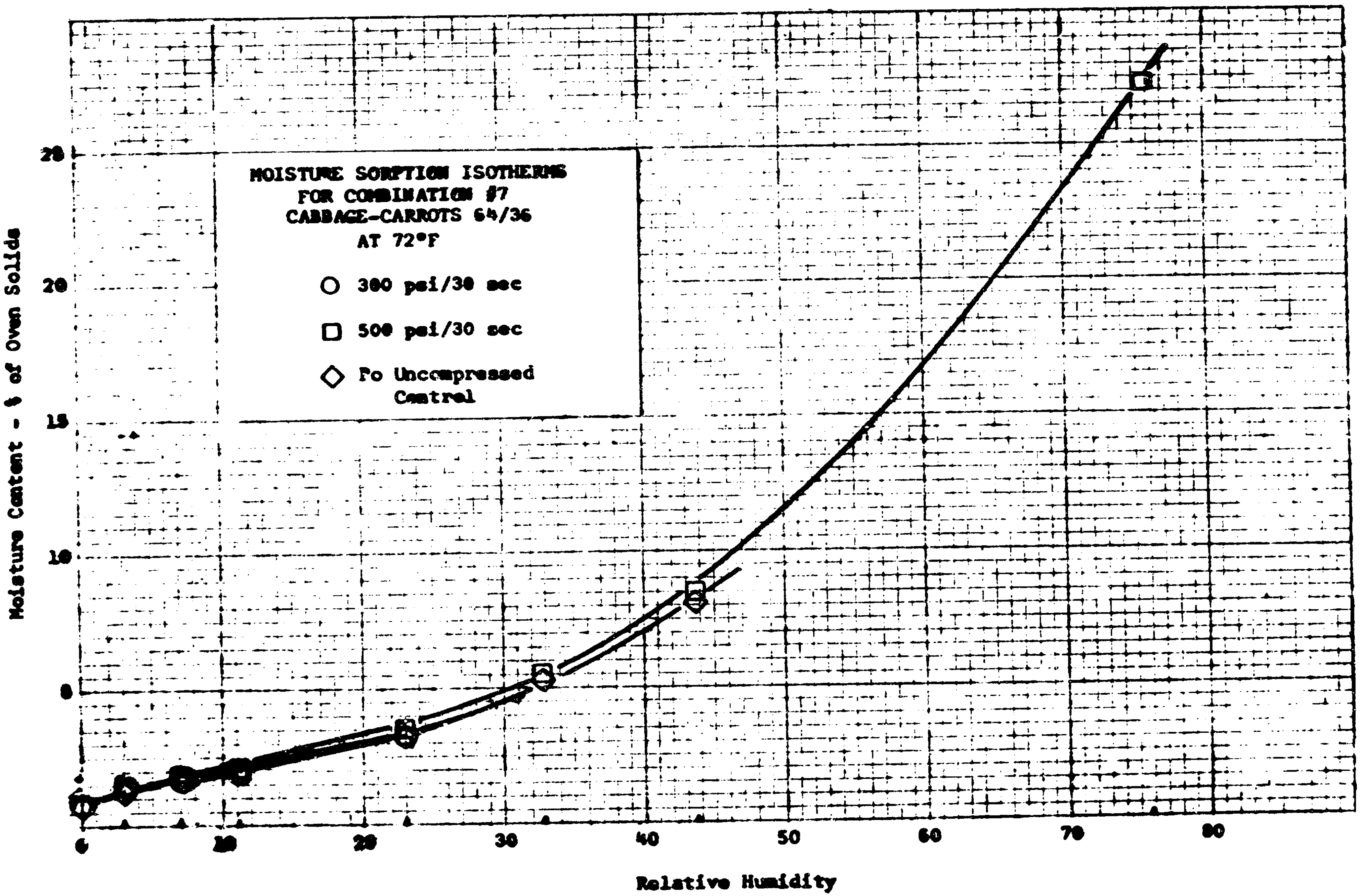

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #7
CABBAGE-CARROTS 64/36
AT 72°F
○ 300 psi/30 sec
□ 500 psi/30 sec
◇ Po Uncompressed Control
Moisture Content - % of Oven Solids
25
20
15
10
5
0
10
20
30
40
50
60
70
80
Relative Humidity

FIGURE XXII

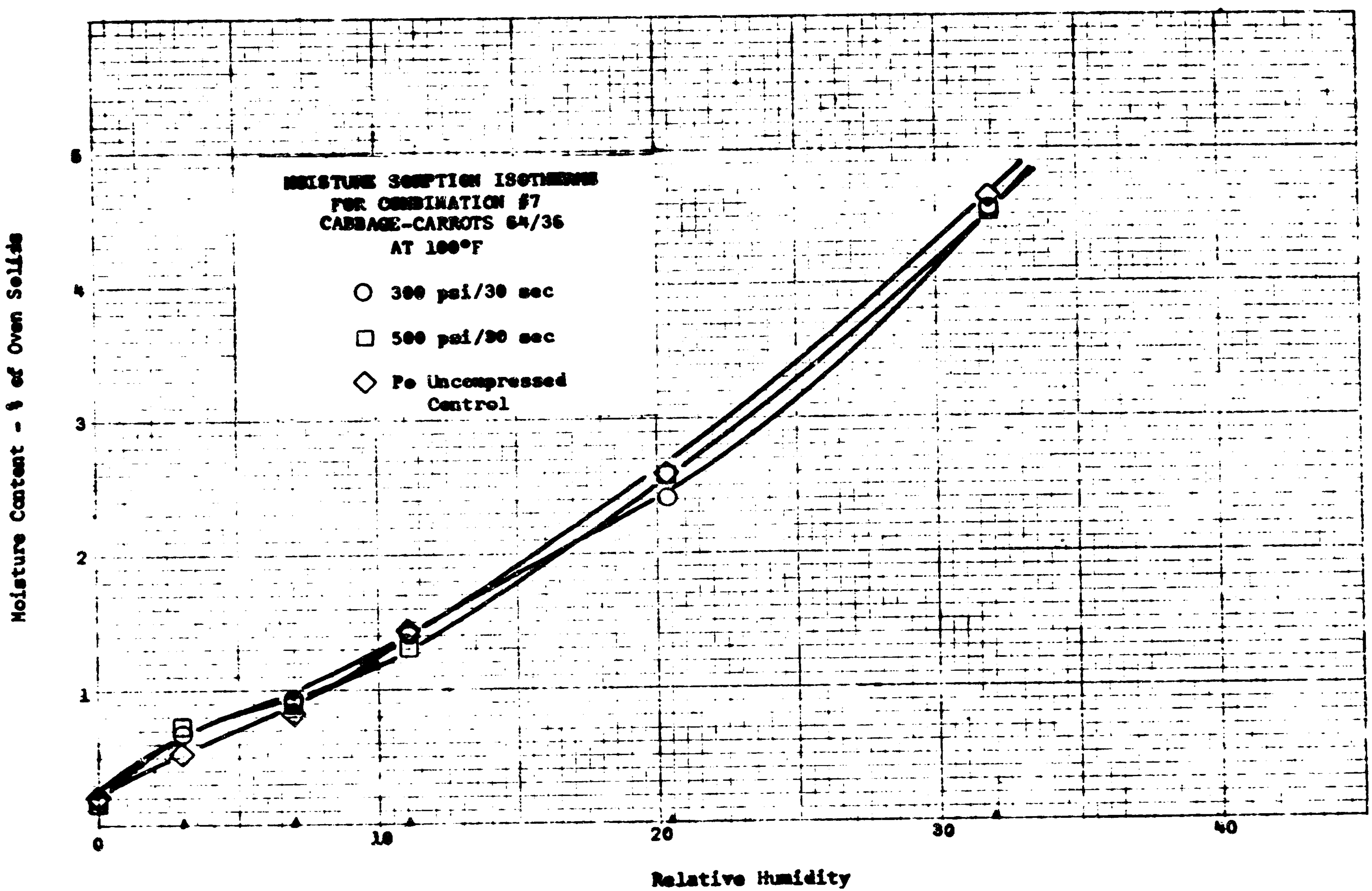
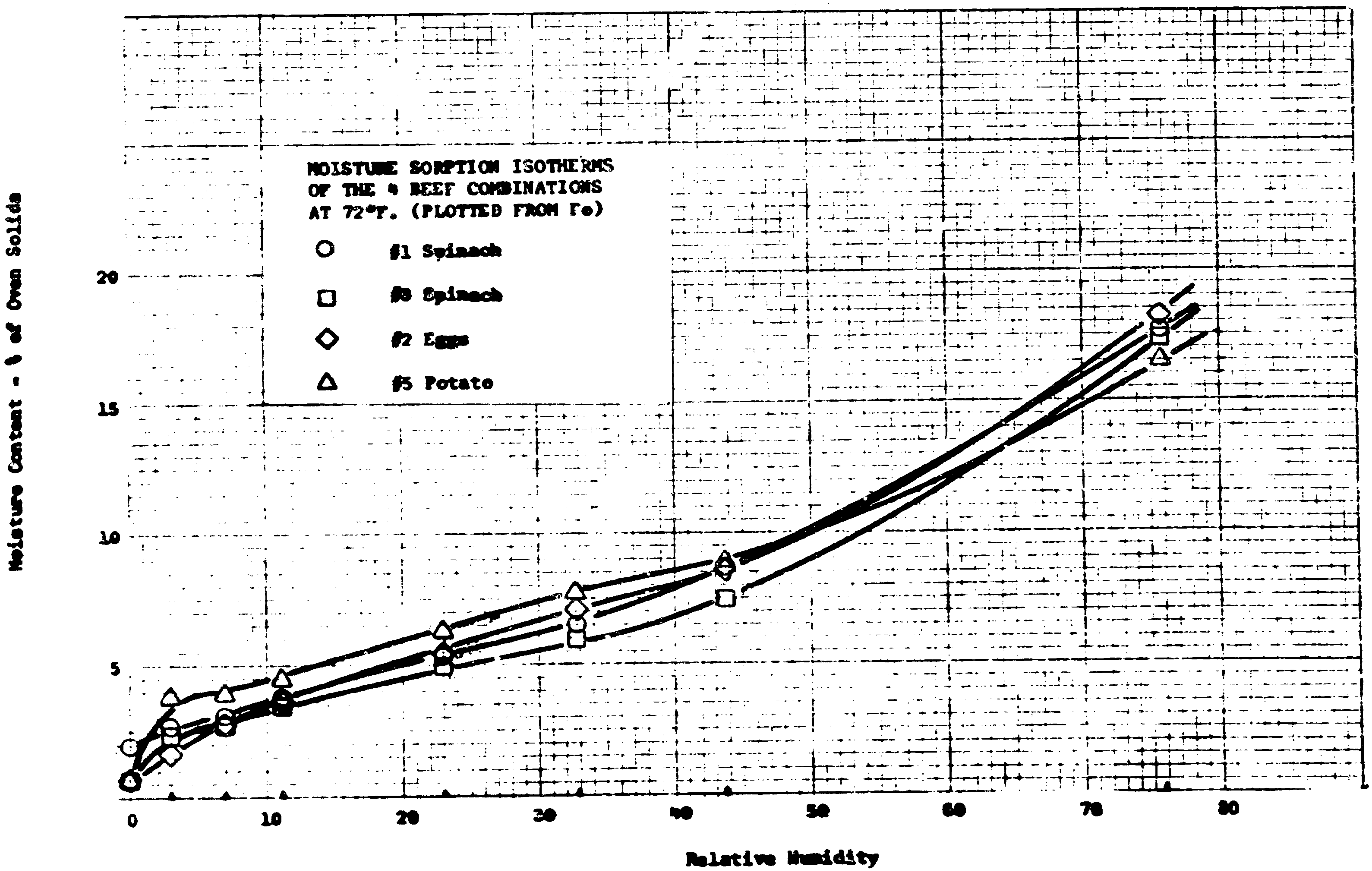


FIGURE XXIII



MOISTURE SORPTION ISOTHERMS
OF THE 4 BEEF COMBINATIONS
AT 72°F. (PLOTTED FROM Fe)
#1 Spinach
#8 Spinach
#2 Eggs
#5 Potato
Moisture Content - % of Oven Solids
0
5
10
15
20
0
10
20
30
40
50
60
70
80
Relative Humidity

FIGURE XXIV

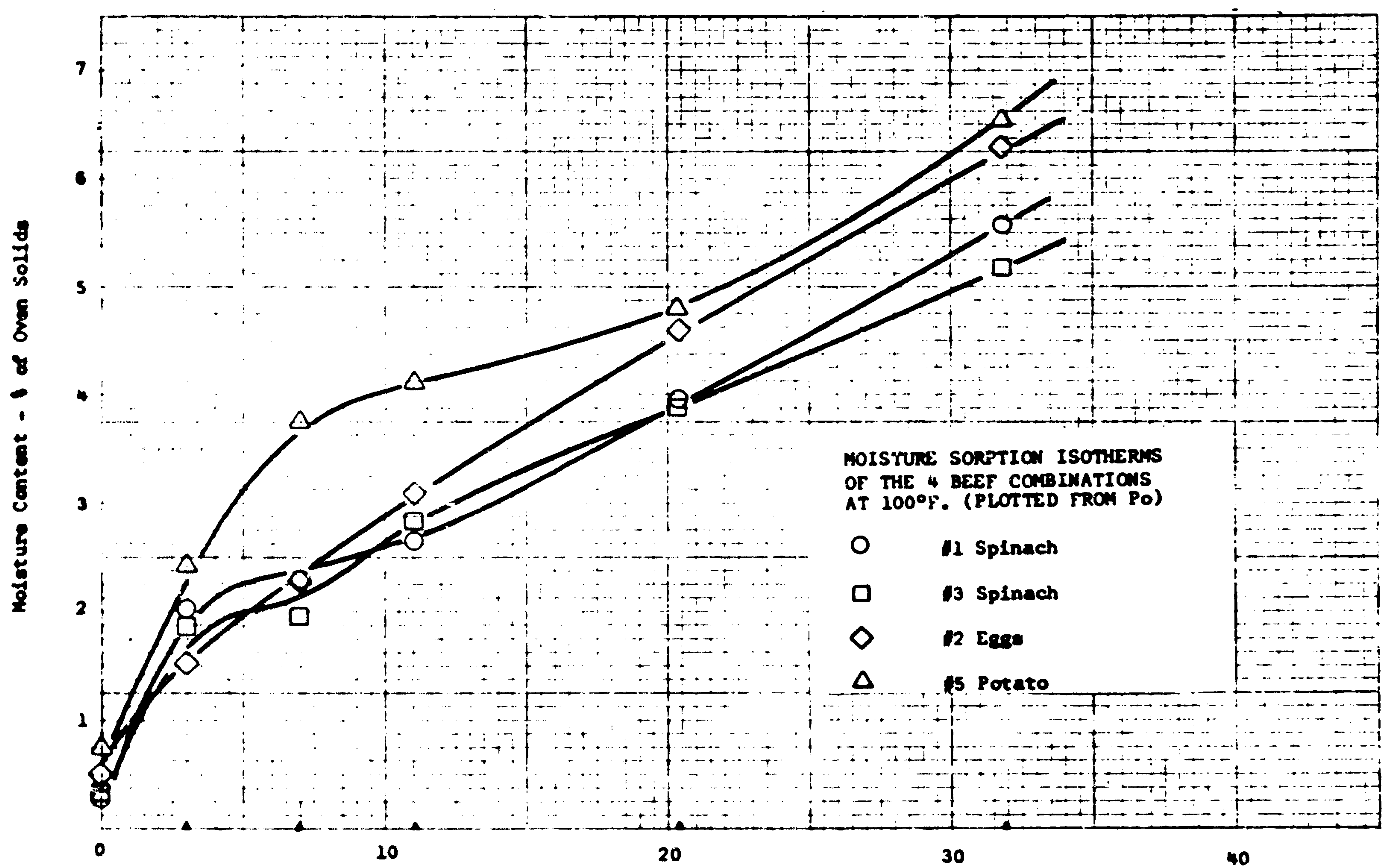

MOISTURE SORPTION ISOTHERMS OF THE 4 BEEF COMBINATIONS AT 100°F. (PLOTTED FROM Po)
#1 Spinach
#3 Spinach
#2 Eggs
#5 Potato
Moisture Content - % of Oven Solids
Relative Humidity
0
10
20
30
40
1
2
3
4
5
6
7

FIGURE XXV

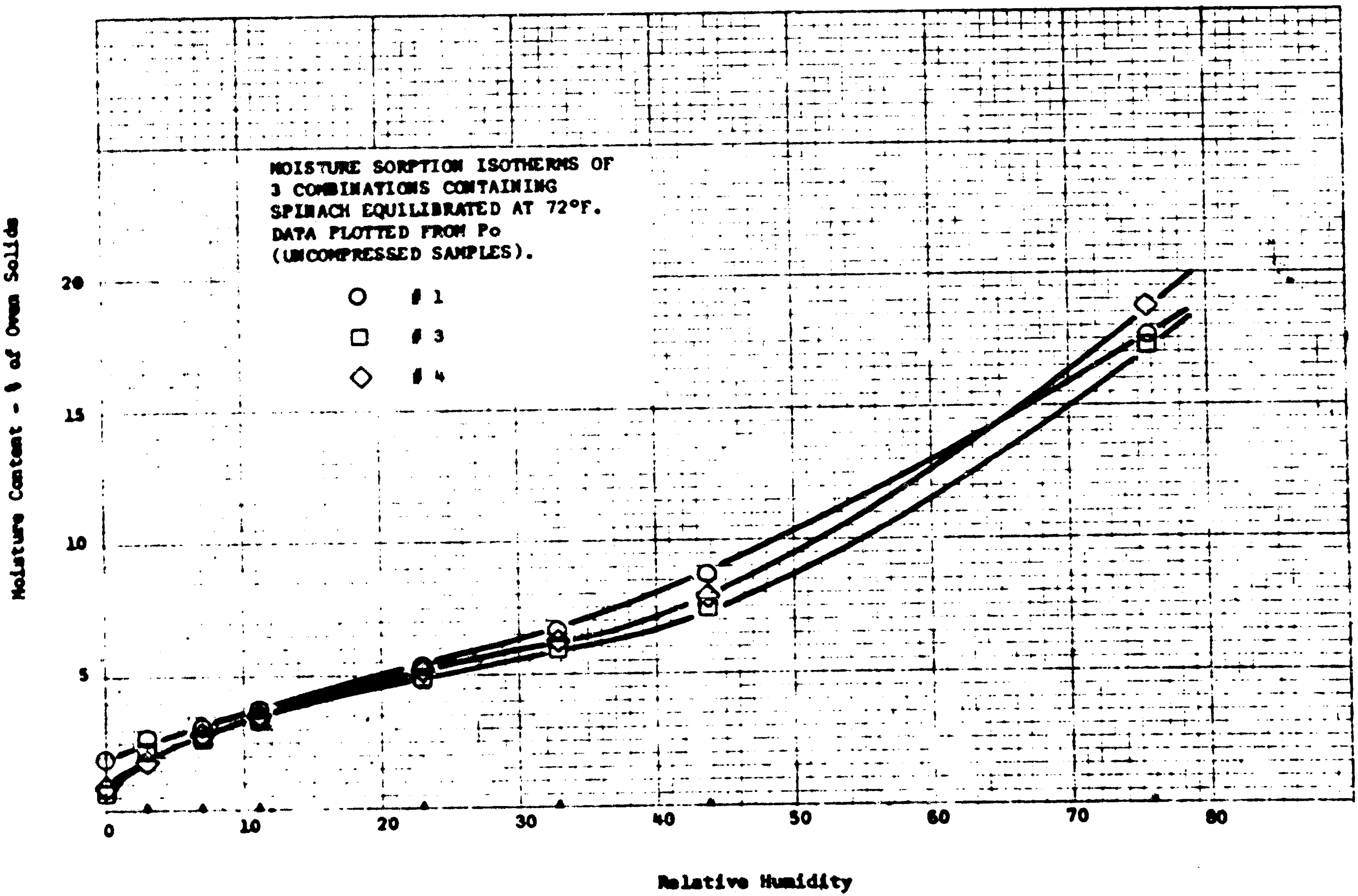

MOISTURE SORPTION ISOTHERMS OF
3 COMBINATIONS CONTAINING
SPINACH EQUILIBRATED AT 72°F.
DATA PLOTTED FROM Po
(UNCOMPRESSED SAMPLES).
1
3
4
Moisture Content - % of Oven Solids
20
15
10
5
0
10
20
30
40
50
60
70
80
Relative Humidity

FIGURE XXVI

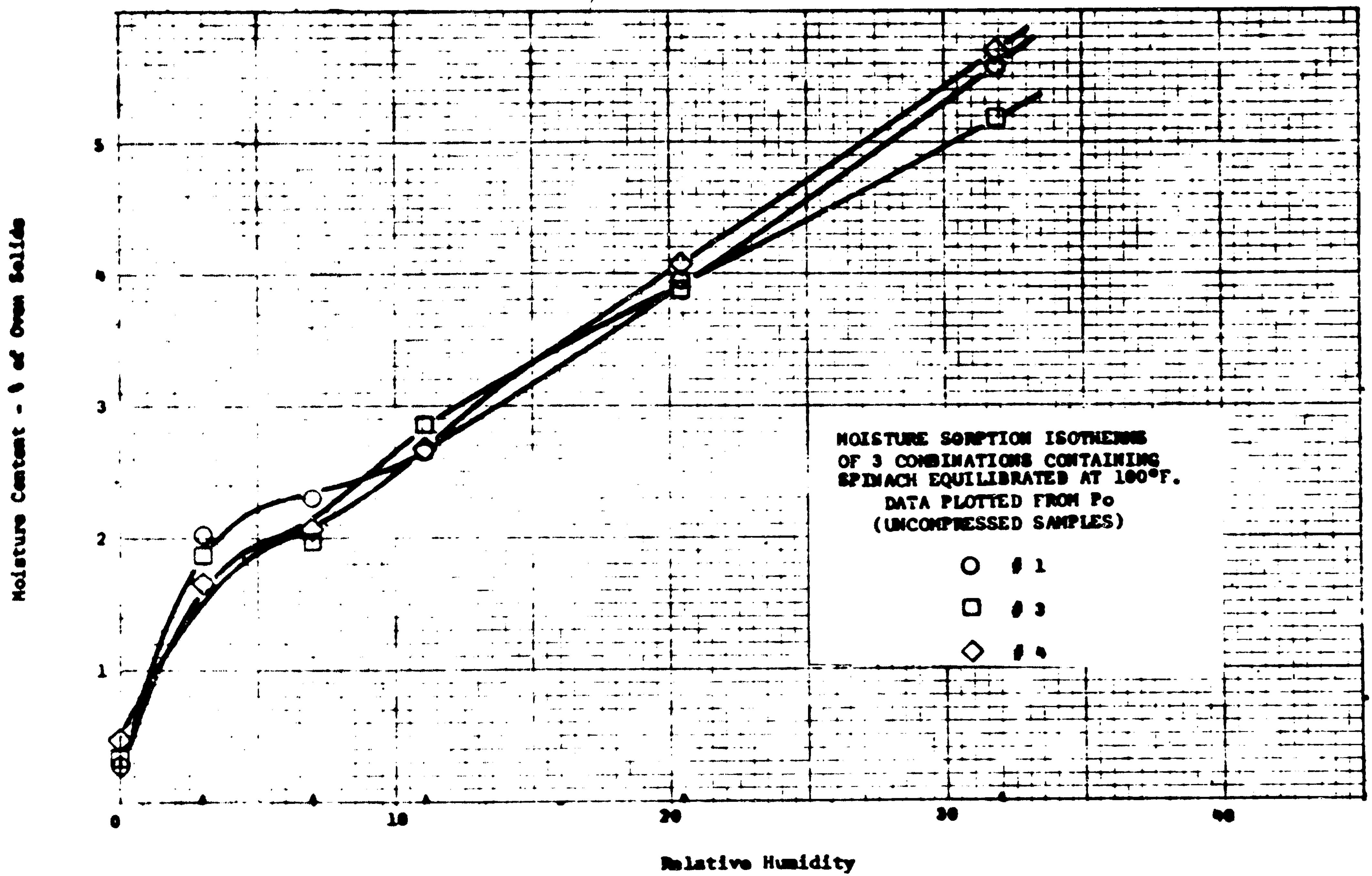


FIGURE XXVII

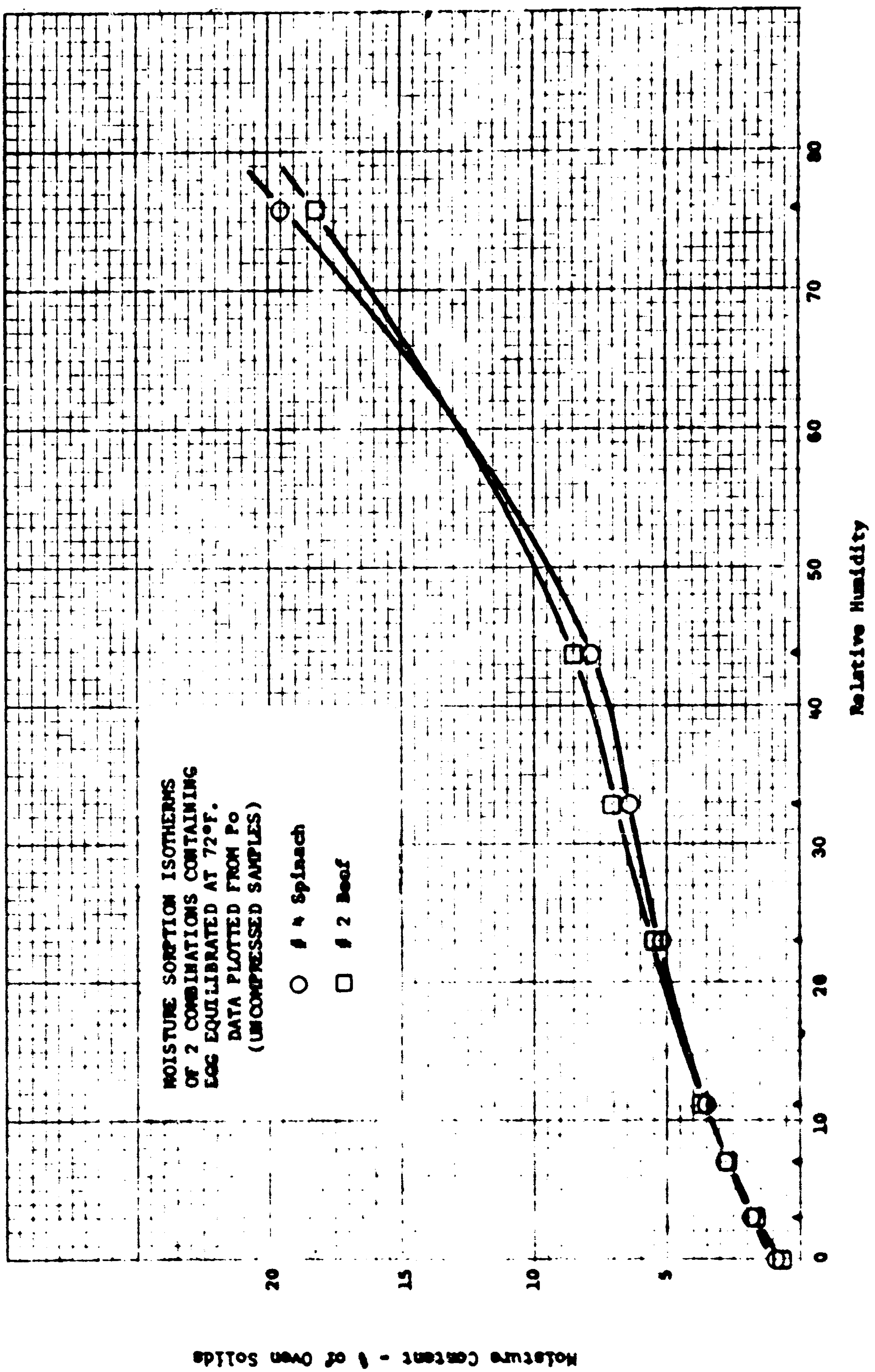
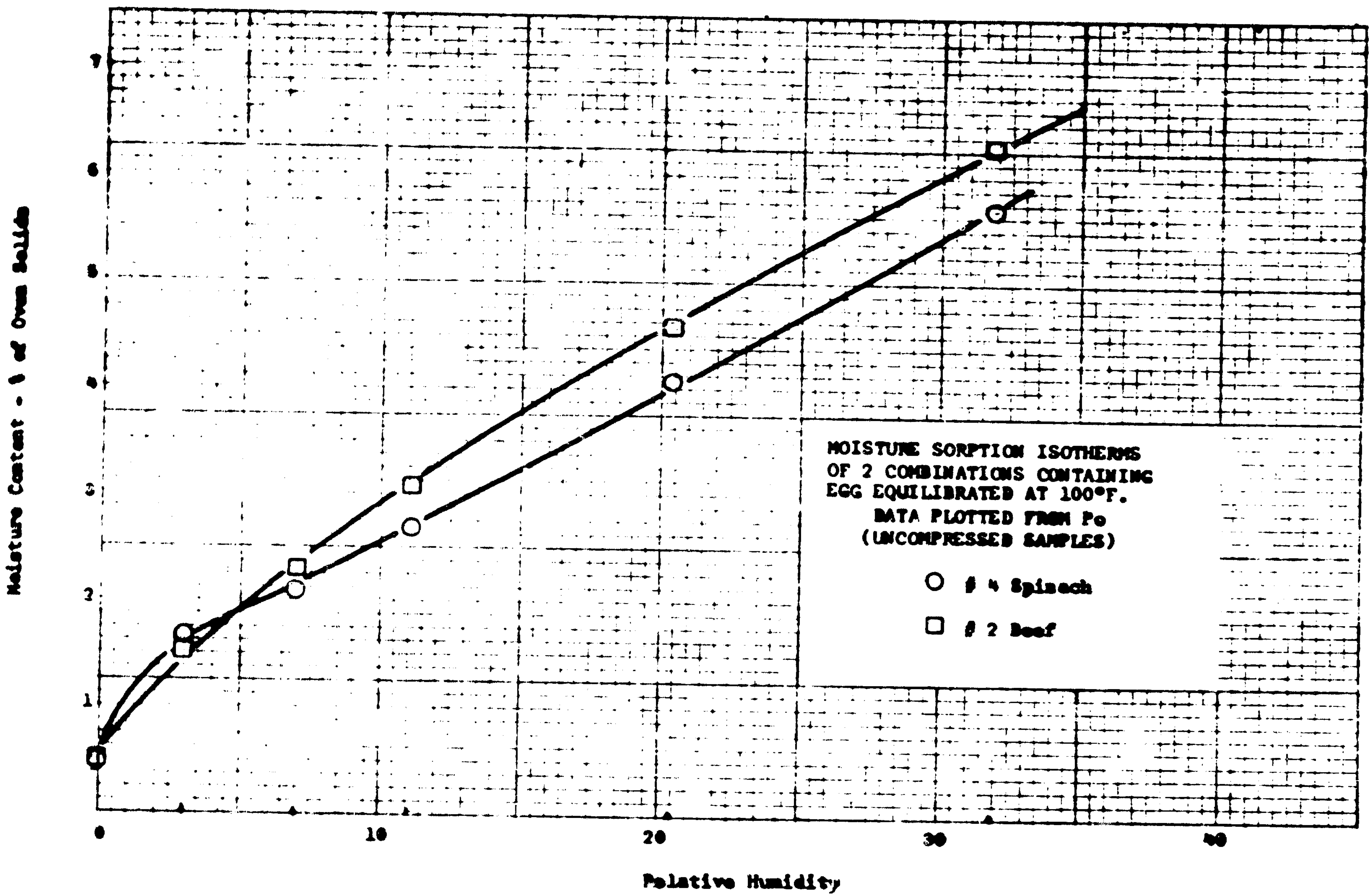


FIGURE XXVIII



MOISTURE SORPTION ISOTHERMS
OF 2 COMBINATIONS CONTAINING
EGG EQUILIBRATED AT 100°F.
DATA PLOTTED FROM Po
(UNCOMPRESSED SAMPLES)
4 Spinach
2 Beef
Moisture Content - % of Oven Solids
Relative Humidity
0
10
20
30
40
1
2
3
4
5
6
7

FIGURE XXIX

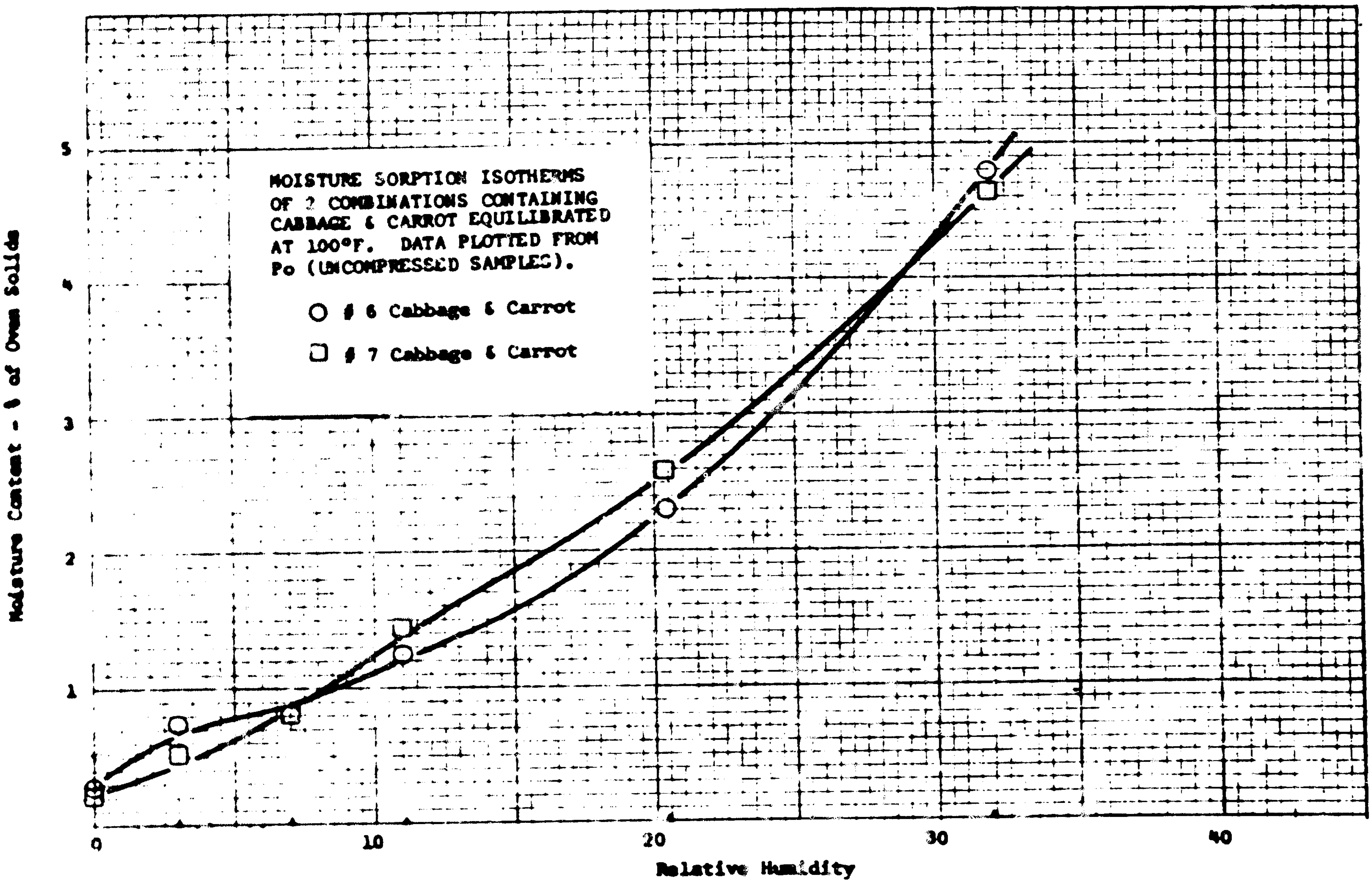

MOISTURE SORPTION ISOTHERMS OF 2 COMBINATIONS CONTAINING CABBAGE & CARROT EQUILIBRATED AT 100°F. DATA PLOTTED FROM Po (UNCOMPRESSED SAMPLES).
○ # 6 Cabbage & Carrot
□ # 7 Cabbage & Carrot
Moisture Content - % of Oven Solids
1
2
3
4
5
0
10
20
30
40
Relative Humidity

FIGURE XXX

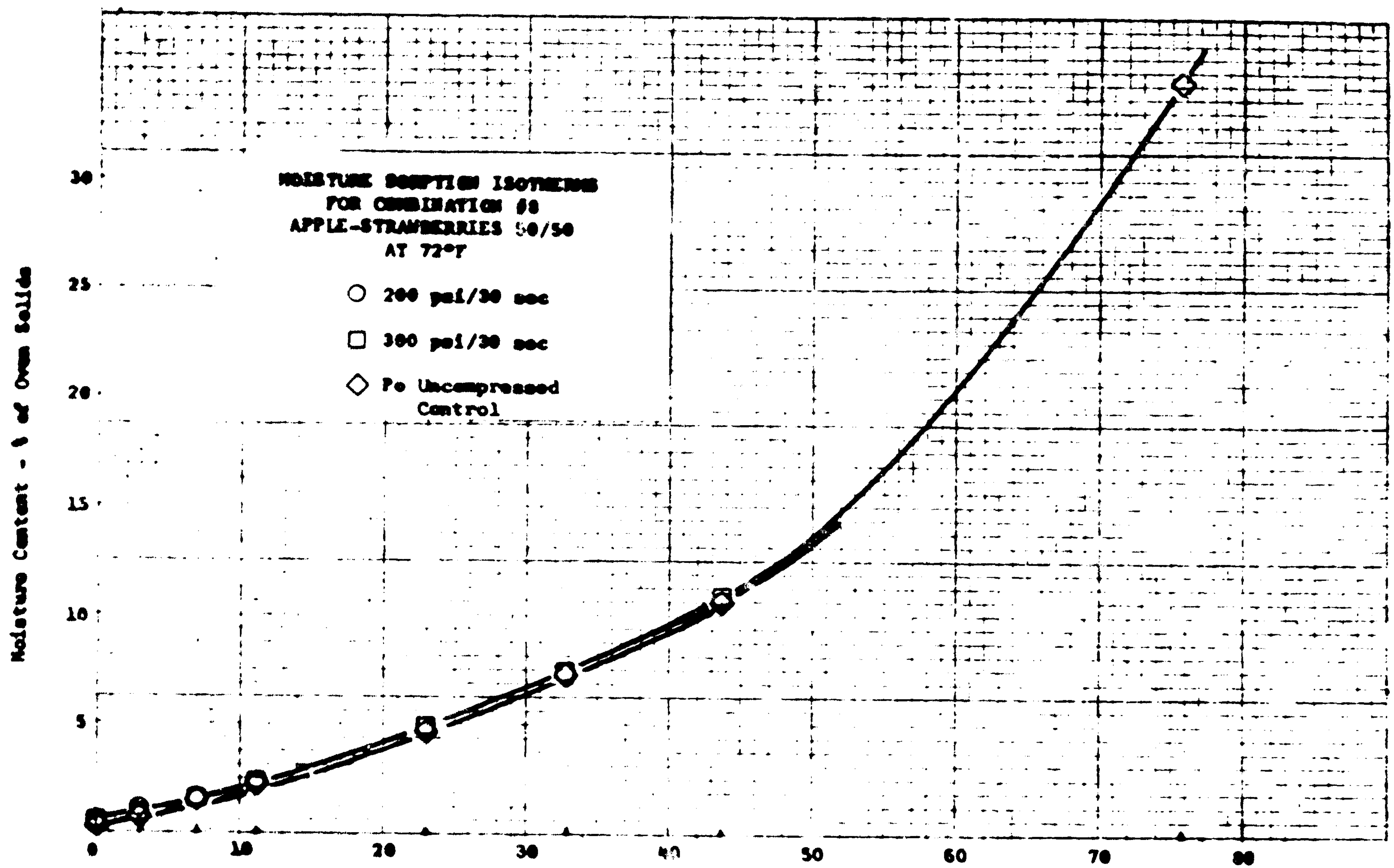

MOISTURE SORPTION ISOTHERMS
FOR COMBINATION #8
APPLE-STRAWBERRIES 50/50
AT 72°F
200 psi/30 sec
300 psi/30 sec
Po Uncompressed
Control
Moisture Content - % of Oven Solids
Relative Humidity
0
10
20
30
40
50
60
70
80
5
10
15
20
25
30

FIGURE XXXI

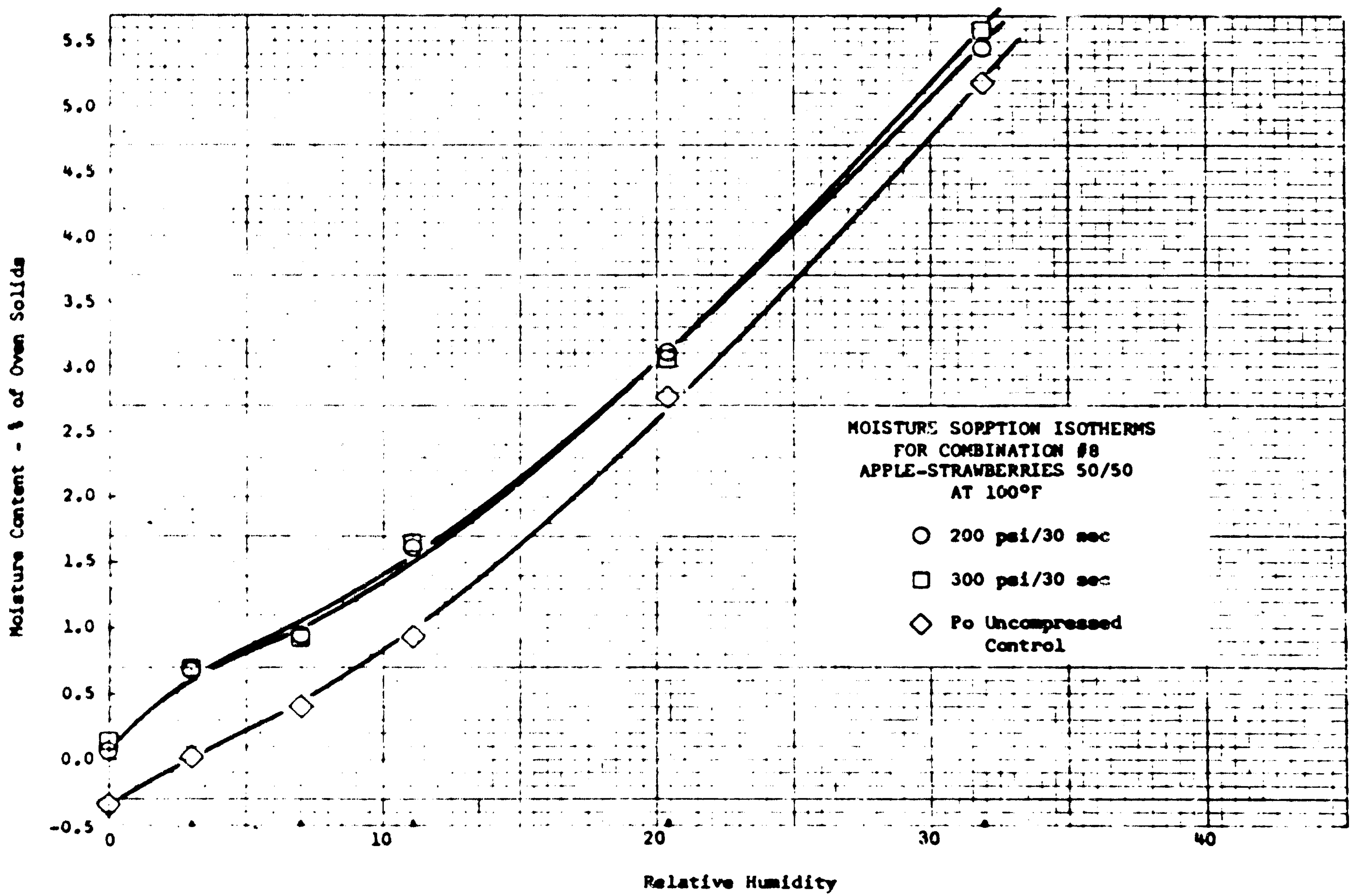


FIGURE XXXII